



DEC 04 2017

MIN-224006

MEMORANDUM TO MINISTER

INTERNATIONAL JOINT COMMISSION
FIRST TRIENNIAL ASSESSMENT OF
PROGRESS ON GREAT LAKES WATER QUALITY

(For Information)

PURPOSE

To provide you with information, as requested by your Office, on the First Triennial Assessment of Progress on Great Lakes Water Quality, released by the International Joint Commission (IJC) on November 28, 2017, pursuant to the 2012 Canada–United States Great Lakes Water Quality Agreement (GLWQA).

SUMMARY

- On November 28, 2017, the IJC released its final report (attached) on the implementation of the GLWQA and progress achieved.
- The IJC commends governments on the new energy and bi-national cooperation over a larger span of issues than was covered by the GLWQA of 1987 and acknowledges the achievement of several time-bounded commitments, such as the establishment of targets for the reduction of phosphorus loadings to Lake Erie and a bi-national approach to the assessment of cumulative threats to nearshore Great Lakes waters.
- The IJC highlights several areas requiring continued or additional effort, including swifter action to restore and protect Lake Erie water quality from excessive phosphorus loadings, accelerated progress in addressing chemicals of mutual concern, and strengthened public engagement. The areas where the IJC recommends additional effort are generally consistent with the Department's strategic direction on freshwater, including allocations in Budget 2017 for new Great Lakes programming. A preliminary analysis of the IJC's recommendations is provided in Annex I (attached).
-
- Communications has been engaged and holding lines have been prepared. Media coverage will be monitored and communications needs will be assessed.

CONTEXT AND CURRENT STATUS

The GLWQA, first signed in 1972 and amended most recently in 2012, established shared objectives and commitments for Canada and the United States with respect to the restoration and protection of the waters of the Great Lakes. The Department and the U.S. Environmental Protection Agency (U.S. EPA) co-lead the implementation of the GLWQA. The IJC plays an important role in assessing the progress of governments on the implementation of the Agreement, including by issuing the triennial assessment of progress report.

The IJC released a draft report for public consultation on January 18, 2017, and released the final report on November 28, 2017. The IJC's assessment of progress includes a summary of public input received through 13 public meetings held in March 2017 and online.

The final report outlines several key findings and recommendations directed to the governments of Canada and the U.S. The IJC commends governments for galvanizing new energy and bi-national cooperation over a larger span of issues than were being addressed under the GLWQA of 1987, for meeting deadlines to set targets for the reduction of phosphorus loadings to Lake Erie, for developing a bi-national approach to assess cumulative threats to nearshore Great Lakes waters, and for issuing a comprehensive report on groundwater science. The IJC also recognizes progress in eliminating new introductions of aquatic invasive species and in the restoration of Areas of Concern identified under the GLWQA.

Areas highlighted as requiring continued or additional effort by governments include:

- continuing financial investment in the restoration and protection of the Great Lakes;
- greater progress towards achieving the human health objectives in the GLWQA;
- accelerating progress in addressing chemicals of mutual concern identified under the GLWQA;
- identifying timelines, responsible entities, deliverables, outcomes, and performance measures to achieve the established reductions in phosphorus loadings to Lake Erie;
- continuing vigilance to prevent new introductions and control the spread of existing aquatic invasive species;
- advancing the implementation of remedial actions to delist the remaining Areas of Concern within 15 years;
- developing a bi-national approach to climate change adaptation and resilience for the Great Lakes;
- strengthening public engagement, with meaningful involvement of all people beyond the audiences typically recognized; and
- further enhancing accountability under the GLWQA.

A preliminary analysis by the Department of the IJC's key recommendations is provided in Annex I.

CONSIDERATIONS

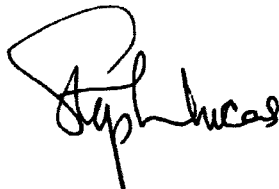
The Department, the U.S. EPA, and other members of the Great Lakes Executive Committee will meet with the IJC as part of the meeting on **December 5 and 6, 2017**, in Toronto to discuss the report's findings.

Pursuant to Article 5 of the GLWQA, governments have six months to transmit a response to the IJC, if it is determined to be necessary.

An initial analysis by the Department (Annex 1) suggests that key recommendations for further action are generally consistent with the Department's strategic direction, including allocations in Budget 2017 for new Great Lakes programming. Opportunities to further enhance implementation based on the IJC recommendations will be explored.

NEXT STEPS

- The IJC will provide an overview of the report at the meeting of the Great Lakes Executive Committee scheduled for December 5 and 6, 2017.
-



Stephen Lucas
Deputy Minister
c.c. Martine Dubuc

Martine Dubuc
Associate Deputy Minister
c.c. Stephen Lucas

Attachments (5):

- *First triennial assessment of progress on Great Lakes water quality: final report (prepared by the International Joint Commission) (November 28, 2017)*
- *Annex I – Preliminary analysis of key recommendations in the First Triennial Assessment of Progress on Great Lakes Water Quality*
- *2016 progress report of the parties pursuant to the Canada–United States Great Lakes Water Quality Agreement*
- *State of the Great Lakes 2017: an overview of the status and trends of the Great Lakes ecosystem – highlights report*
- *News release of December 1, 2017 – The Government of Canada invests in Great Lakes Protection Initiative*

BACKGROUND

The Canada–United States Great Lakes Water Quality Agreement (GLWQA) has been an important framework since 1972 for ensuring bi-national consultation and cooperative action to restore, protect, and enhance the water quality and ecological health of the Great Lakes.

The GLWQA was most recently amended in 2012 to reflect the latest in environmental policy for the Great Lakes. The 2012 GLWQA modernized existing provisions related to excessive algae growth, chemicals, ship pollution, and scientific research. It also incorporated, for the first time, commitments to address other significant challenges to Great Lakes water quality, including the threat posed by aquatic invasive species and climate change, as well as the loss of habitat and species.

Approaches to governance and management were also enhanced under the 2012 GLWQA. The Great Lakes Executive Committee was established to advise and assist the Parties in coordinating, implementing, reviewing, and reporting on programs, practices, and measures that support the implementation of the GLWQA. Co-chaired by the Department and the U.S. Environmental Protection Agency, the Great Lakes Executive Committee includes senior level representatives from the two federal governments, state governments, the Ontario government, Tribal Governments, First Nations, Métis, municipal governments, watershed management agencies, and other local public agencies. In addition, a formal committee structure, reporting to the Great Lakes Executive Committee, was established to work bi-nationally to implement commitments in the annexes to the 2012 GLWQA. Regular public reporting on a triennial cycle was also implemented under the 2012 GLWQA through the progress report of the Parties, in addition to other specific reporting called for under various annexes.

Article 7 of the 2012 GLWQA specifically tasks the International Joint Committee (IJC) with assessing and reporting on the Parties' progress in implementing the Agreement once every three years. The IJC's assessment of progress report includes a review of the progress report of the Parties (the 2016 report is attached); a summary of public input on the progress report of the Parties; an assessment of the achievement of the objectives of the GLWQA; consideration of the state of the Great Lakes report (the State of the Great Lakes 2017 highlights report is attached); and other advice and recommendations.

Pursuant to Article 5 of the GLWQA, the Parties shall review each triennial assessment of progress report, consult with each other on the recommendations contained in the report, and consider such action as may be appropriate, and, if deemed necessary, may transmit a response and comments to the IJC within six months of receipt of the report.

Information from the IJC's assessment will be considered and used by Canada and the U.S. to enhance future progress reports of the Parties and strengthen GLWQA implementation efforts.

ANNEX I

PRELIMINARY ANALYSIS OF KEY RECOMMENDATIONS IN THE FIRST TRIENNIAL ASSESSMENT OF PROGRESS ON GREAT LAKES WATER QUALITY

1) Implementation of the 2012 GLWQA – To continue and improve successes in Great Lakes Water Quality Agreement (GLWQA) implementation, the International Joint Commission (IJC) recommends that governments' financial investment in improving the water quality of the Great Lakes continue at current or higher levels.

Analysis: Budget 2017 increased investment in the protection of the Great Lakes with an additional \$44.84 million over five years for the Great Lakes Protection Initiative (see attached news release). An additional \$43.8 million over five years was allocated to Fisheries and Oceans Canada to address the threat of aquatic invasive species in the Great Lakes and across Canada.

2) Protecting Human Health – Seven recommendations address enhancing progress and reporting on the human health objectives; in particular, the IJC calls for zero discharge of inadequately treated or untreated sewage into the Great Lakes along with sufficient resources to achieve this by an accelerated and fixed period, as well as increased infrastructure funding and support to communities to respond to extreme storm events.

Analysis: More than \$180 billion is being invested in infrastructure over 12 years through Investing in Canada, which includes \$26.9 billion in green infrastructure to support priorities that include access to clean, safe water for all Canadians. In September 2016, Canada and Ontario announced a bilateral agreement that will make more than \$1.1 billion in combined funding available under this program to improve water and wastewater infrastructure across Ontario.

3) Pollutants – The IJC recommends accelerating work on strategies and the implementation of actions to eliminate chemicals of mutual concern, including through policies and programs based on the principles of extended producer responsibility.

Analysis: In May 2016, the Department and the U.S. EPA designated eight chemicals of mutual concern for targeted action in the Great Lakes. Strategies for two of these chemicals are close to being finalized, and development of strategies for the others is well underway. Budget 2017 provided \$1.8 million to support the demonstration of innovative approaches to reduce releases of chemicals of mutual concern through the Great Lakes Protection Initiative.

4) Nutrients – The IJC recommends enforceable standards addressing the application of agricultural fertilizer and animal wastes, and the IJC recommends that the domestic action plans being developed for Lake Erie include details on timelines and performance metrics in order to strengthen accountability.

Analysis: The joint Canada–Ontario domestic action plan to reduce phosphorus loadings to Lake Erie from Canadian sources is currently undergoing a second round of public consultations and is targeted for finalization and release in February 2018. It includes a commitment to strengthen relevant policies and programs, including consideration of further provincial restrictions on the application of nutrients during the non-growing season; a provincial review of agricultural drainage legislation, policies, and programs; strengthened provincial effluent discharge limits for municipal sewage treatment plants; and The domestic action plan is supported by \$26 million from Budget 2017 (part of the Great Lakes Protection Initiative) for science and the development, demonstration, and promotion of innovative approaches to reducing phosphorus loadings.

5) Invasive Species – Several recommendations relate to ballast water exchange and the threat posed by Asian carp; in particular, the IJC calls for increased control of the spread of aquatic invasive species already in the Great Lakes.

Analysis: Fisheries and Oceans Canada and Transport Canada lead on aquatic invasive species and ballast water issues, respectively. Budget 2017 allocated new resources of \$43.8 million over five years to Fisheries and Oceans Canada to address the threat of aquatic invasive species in the Great Lakes and across Canada.

6) Addressing Areas of Concern – The IJC recommends that governments commit to the completion of the remediation of the Areas of Concern within 15 years.

Analysis: Three Canadian Areas of Concern designated under the GLWQA have been fully remediated and delisted; all remediation actions have been completed for a further 2; and remediation actions are well advanced in the remaining 12. Completion of work within the next 15 years is achievable;

7) Coping with Climate Change – The IJC recommends a bi-national approach to climate change adaptation and resilience and a bi-national assessment of vulnerability to climate change to demonstrate climate change leadership for the Great Lakes.

Analysis: Budget 2017 provided \$7 million (part of the Great Lakes Protection Initiative) to assess the vulnerability of shoreline wetlands to climate change and other factors and to engage others in building consensus on priority actions to reduce the threat of wetland loss and degradation. U.S. federal participation on climate change is limited.

8) Engagement – The IJC recommends accelerating and deepening the approach to public engagement, especially in Lakewide Action and Management Plans (LAMPs), going beyond the audiences typically recognized.

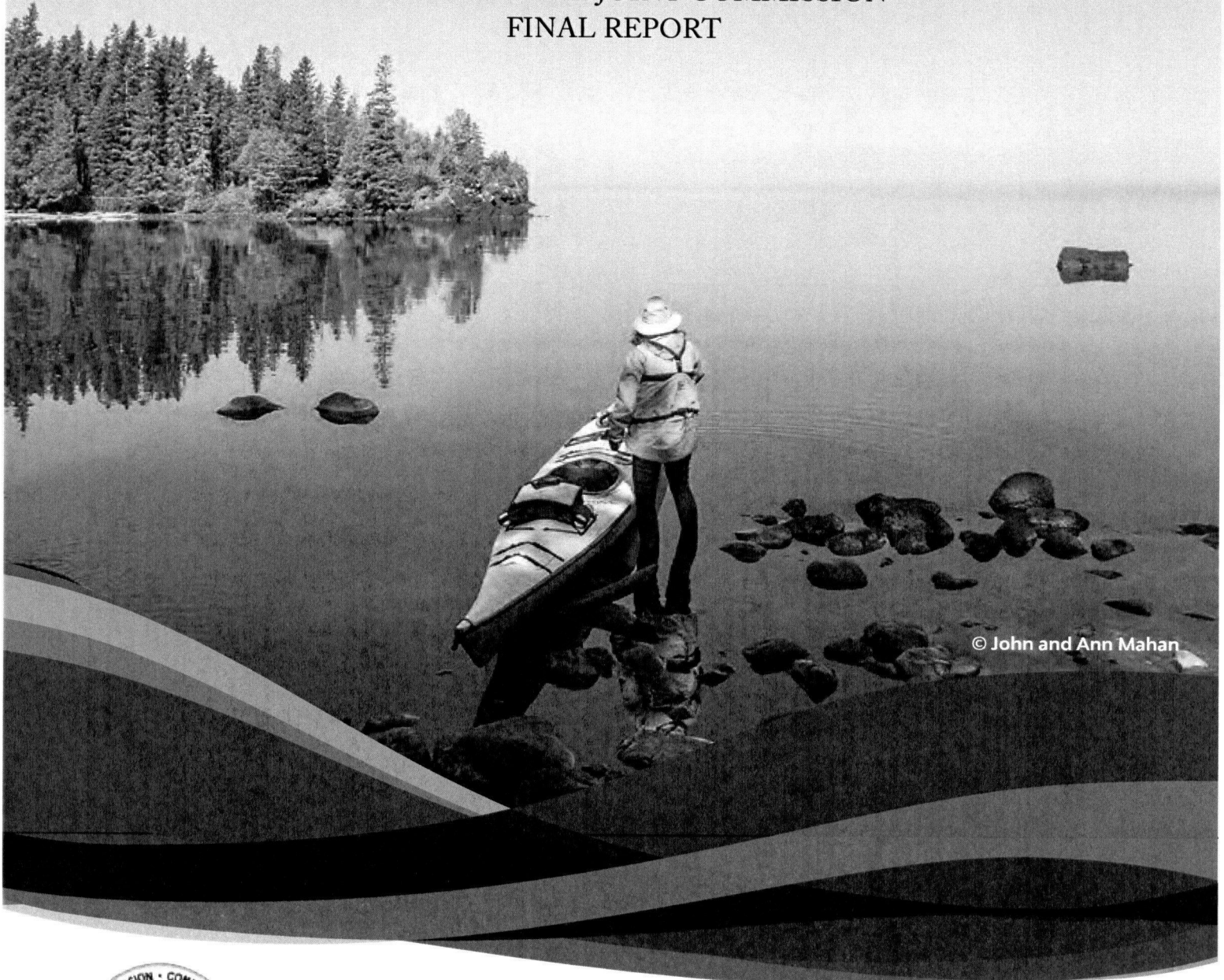
Analysis: Engagement of stakeholders and the public has been significantly enhanced through the implementation of the 2012 GLWQA. Budget 2017 provided (as part of the Great Lakes Protection Initiative) \$2.6 million to enhance Indigenous capacity to participate in Great Lakes decision-making processes and in taking action to address Great Lakes issues of concern to them and another \$2 million to engage the public through citizen science initiatives. The Department continues to explore opportunities to enhance public engagement in the implementation of the GLWQA, with a focus on engaging on a lake-by-lake basis, and will explore the use of social media and online approaches.

9) Accountability – The IJC recommends clear, time-bounded targets for action as well as long-term aspirations for improvement in the status and trends of Great Lakes indicators against which progress can be more definitively assessed. The IJC also calls for strengthened support for a comprehensive bi-national monitoring program for the Great Lakes.

Analysis: Canada and U.S. issue the state of the Great Lakes report every three years. Establishing timelines for achieving water quality improvements in an ecosystem as large and complex as the Great Lakes is challenging and may lead to unrealistic expectations.

~ FIRST TRIENNIAL ASSESSMENT OF PROGRESS ON~
**GREAT LAKES
WATER QUALITY**

INTERNATIONAL JOINT COMMISSION
FINAL REPORT



© John and Ann Mahan




Prepared by
The International Joint Commission Pursuant
to Article 7 (1) (k) of the 2012 Great Lakes Water
Quality Agreement

NOVEMBER 28, 2017



© snoopymysp - Fotolia / Adobe Stock



*“Environmental
pollution is an incurable
disease. It can only
be prevented.”*

– Barry Commoner

Barry Commoner (1917-2012) was an American biologist, college professor and politician, and among the founders of the modern environmental movement.

COMMISSIONERS

Lana Pollack

Gordon Walker

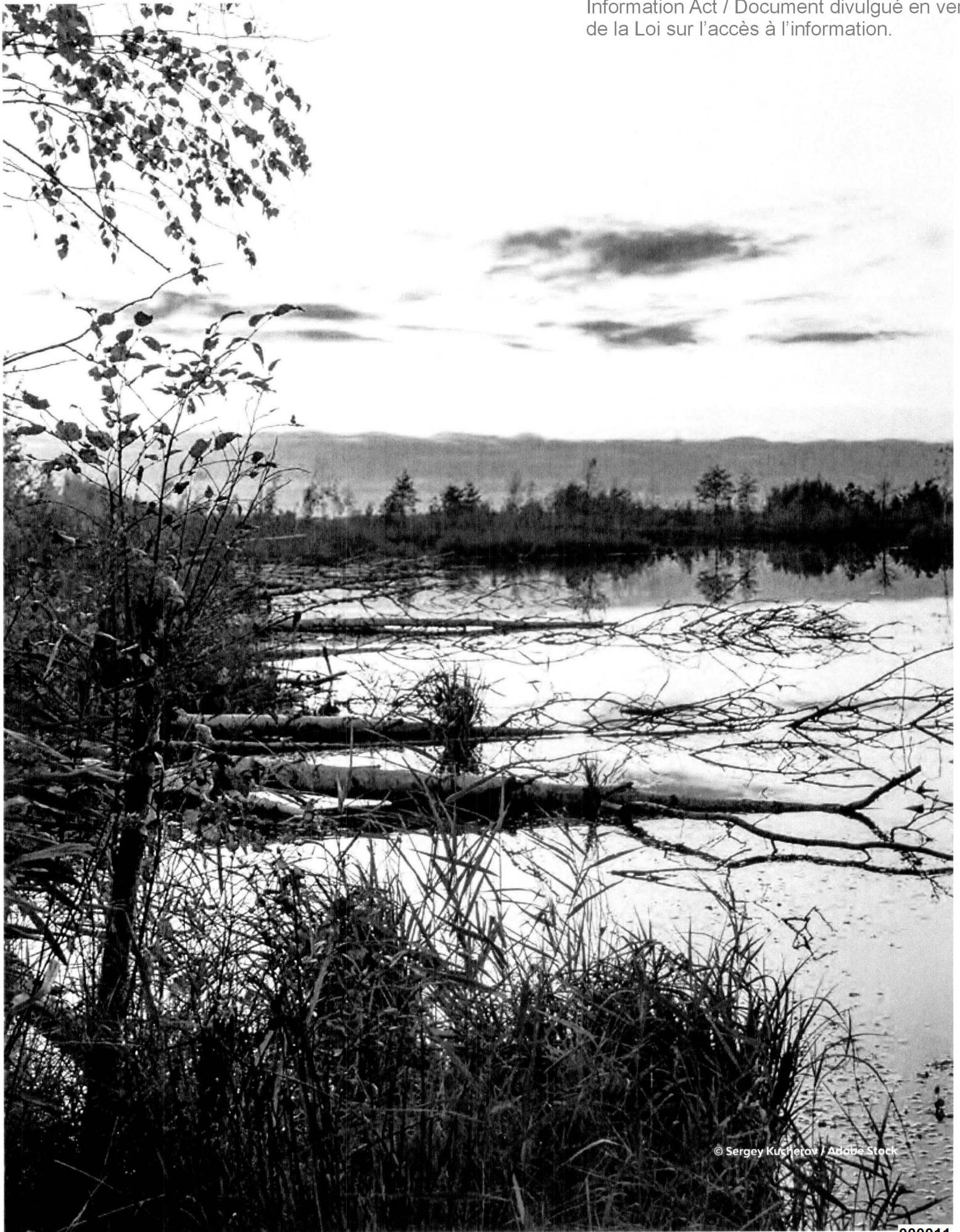
Rich Moy

Benoit Bouchard

Richard Morgan

November 28, 2017

Please go to <http://ijc.org/files/tinymce/uploaded/GLWQA/TAP.pdf> to download the full Triennial Assessment of Progress report, to http://ijc.org/files/tinymce/uploaded/GLWQA/TAP_TA.pdf to download the Technical Appendix, and to http://ijc.org/files/tinymce/uploaded/GLWQA/TAP_PCA.pdf to download the Summary of Public Comment Appendix.



© Sergey Kuchetov / Adobe Stock



MESSAGE FROM THE INTERNATIONAL JOINT COMMISSION

Governments exist to serve the people. With this in mind, the International Joint Commission presents its first triennial assessment of progress on Great Lakes water quality pursuant to Article 7.1 (k) of the 2012 Great Lakes Water Quality Agreement (GLWQA).

This report provides advice and recommendations to assist the federal governments to better meet the general and specific objectives of the GLWQA. The advice and recommendations found in this report may also be applicable to other levels of government, academia, nongovernmental organizations, private industry and the public.

This report is grounded in science and rooted in the values and views of the many individuals who comprise the Great Lakes community. After releasing a draft of this report in January 2017, the Commission sought the community's reactions through thirteen public meetings, roundtables and listening sessions, through our online democracy platform, Participate IJC, and our newsletters, social media and website, and via email and letters.

The dialogue was robust. The public raised more than 65 issues and provided insight and advice. While the Commission did not research or incorporate in its recommendations all the public's concerns, it found much value in the insights of those who contributed during the open comment period.

For the last 45 years, since the initial signing of the Agreement, the governments of both great nations have recognized their responsibilities, as trustees of the lakes on behalf of their citizens, to protect, defend and restore the multiple values of these freshwater jewels. This report is a direct outgrowth of their commitment to be accountable to the public for the fulfillment of these responsibilities. The Agreement has evolved since 1972 to reflect a changing scientific understanding of the lakes, a growing binational relationship, and emerging challenges such as climate change.

Why is the Commission charged with preparing this report? Since the 1978 revision of the water quality agreement, the International Joint Commission has served as an independent assessor of the progress made by the two governments in achieving the Agreement's objectives.

The Commission wishes to acknowledge other governments deeply concerned with the health of the Great Lakes. Amongst these governments are Tribal, First Nations and Métis governments. These governments and their peoples need to be engaged as rights holders with recognition and appreciation of their governance, identity, cultures, interests, knowledge and traditional practices.

Commissioners appreciate the essential support of its staff in preparing this report and want to note with respect and gratitude the valuable contributions made by the Great Lakes Water Quality Board, the Great Lakes Science Advisory Board

and the Health Professionals Advisory Board of the IJC, as well as the public and indigenous peoples. The Commission strongly encourages a continuing dialogue and engagement with all groups to sustain the restoration, maintenance and protection of the lakes for future generations. Commissioners hope that this report will be an important part of this dialogue.

The governments of Canada and the United States and Great Lakes civil society as a whole are living with the costly consequences of past failures to anticipate environmental problems. In making this assessment of progress, the Commission viewed matters through the prism of prevention, how lessons learned from the past are used to avoid current and future problems. Actions by the governments to implement the GLWQA were reviewed not just with respect to what existing water quality issues were addressed but also with respect to actions taken to prevent new degradation of water quality from occurring. The Commission urges both countries to adhere to the prevention principle they wisely incorporated in the 2012 revision to the GLWQA. A number of recommendations provided in this report offer specific examples of how this can be implemented.

Despite different perspectives and opinions, there is a value shared among the peoples of the lakes: that all the riches of the Great Lakes matter, and that we must do our best to preserve them for all time. We hope this report will contribute to that cause.



Gordon Walker
Canadian Section Chair

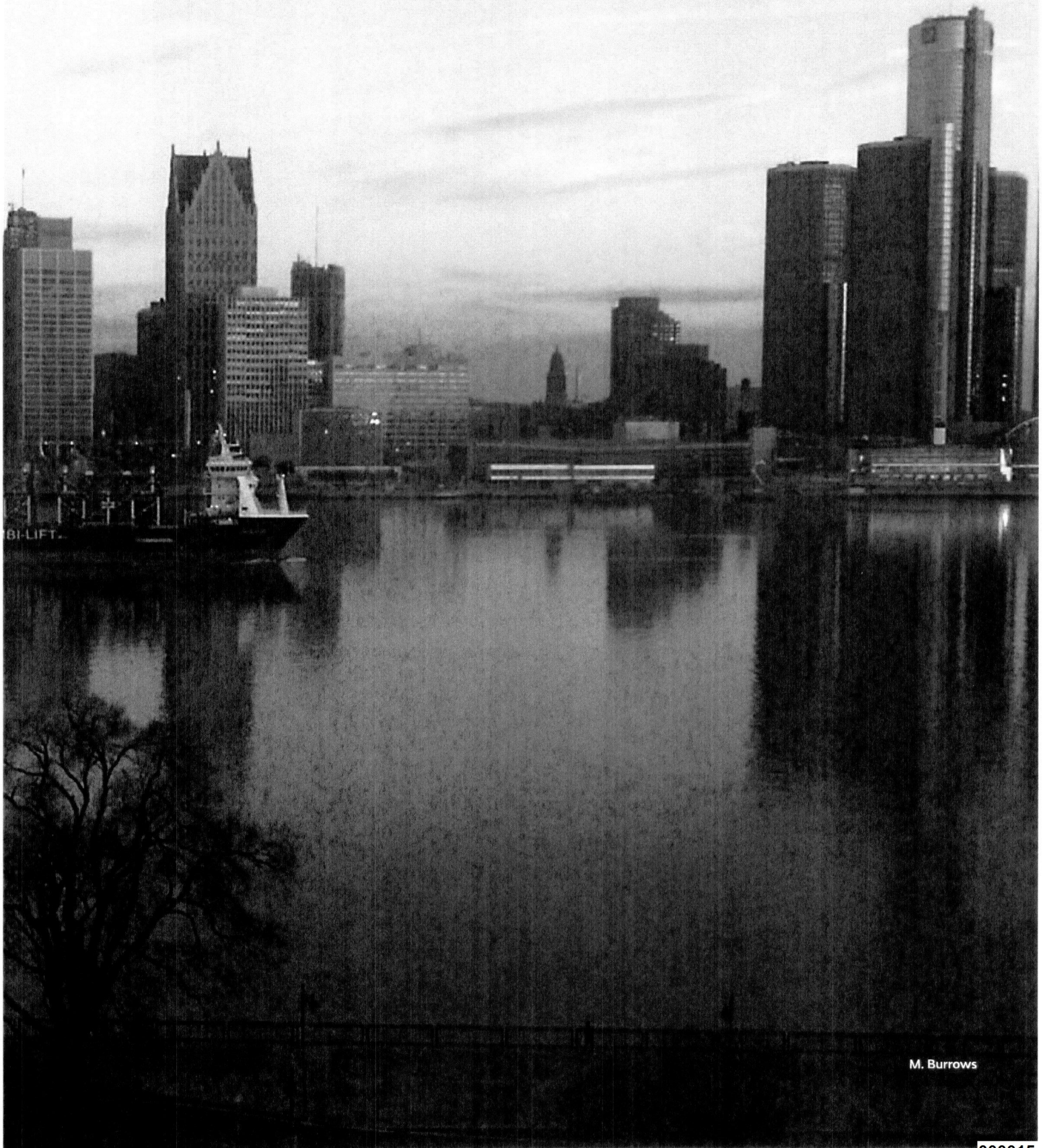
Lana Pollack
United States Section Chair

Benoît Bouchard
Canadian Commissioner

Rich Moy
United States Commissioner

Richard Morgan
Canadian Commissioner





M. Burrows



EXECUTIVE SUMMARY

The International Joint Commission (IJC or Commission) is charged by the 2012 revision of the Great Lakes Water Quality Agreement (referred to throughout this report as GLWQA or Agreement) to submit a triennial assessment of progress regarding Great Lakes water quality to the United States and Canadian governments (the Parties to the GLWQA). Pursuant to Agreement Article 7.1 (k) the Assessment of Progress Report is to include:

- i. a review of the Progress Report of the Parties;
- ii. a summary of public input on the Progress Report of the Parties;
- iii. an assessment of the extent to which government programs and measures are achieving the General and Specific Objectives of this Agreement;
- iv. consideration of the most recent State of the Lakes Report; and
- v. other advice and recommendations, as appropriate.

This report fulfills these requirements.



This is the IJC's first triennial report under the 2012 GLWQA. In submitting it to the Parties, the Commission believes it will also be useful to other orders of government, and all people who care about the well-being of the lakes.

The IJC finds much to commend in the Parties' work under the GLWQA. In this first triennial cycle of implementation, the Parties successfully met deadlines to develop priorities for science and action, propose a nearshore framework, and set phosphorus load reduction targets for Lake Erie. The 2012 GLWQA also galvanized new energies and activity over a larger span of issues than was covered by previous versions of the Agreement.

Progress toward meeting the GLWQA's general objectives includes accelerated restoration of contaminated Areas of Concern, the development of binational habitat conservation strategies, the absence of newly introduced aquatic invasive species, and comprehensive reporting on groundwater science. But more work needs to be done.

Significant challenges include the increase in harmful algal blooms in Lake Erie, the slow pace in addressing chemicals of mutual concern, and the spread of previously introduced invasive species. Governments also need to pay additional attention to infrastructure investments that are essential to eliminate the discharge of untreated or insufficiently treated waste into the Great Lakes and reduce risks to human health.

The IJC firmly believes that achieving the GLWQA's purpose and objectives will happen only if all sectors of the Great Lakes community are involved. Article 7 of Agreement requires the Commission to consult on a regular basis with the public, increase awareness of the lakes' inherent value, and prepare a summary of public input on the Progress Report of the Parties. The IJC conducted extensive public engagement activities to meet these requirements and to solicit views from the public on a draft of this report released in January 2017. The Commission received input at thirteen public meetings, roundtables and listening sessions, through the online democracy platform, Participate IJC, and its newsletters, social media and website, and via email and letters. All comments were carefully considered in the production of this triennial assessment of progress report.

Article 2 of the GLWQA sets forth a set of 16 principles and approaches the Parties agree to use in Agreement implementation. The IJC views three as especially important: prevention, foremost, followed by accountability and engagement. The Commission identified progress on each of these three principles and approaches, but

adds that improvements are needed to fully realize their potential.

Based on its assessment of progress and the input received from the public, the Commission presents this summary of key findings and recommendations from the report.

IMPLEMENTING THE GLWQA

The IJC finds that the 2012 GLWQA galvanized new energies, activity and binational cooperation. **The Parties are to be commended for authoring the new GLWQA, giving it momentum and harmonizing implementation activities.** In just three years, the Parties have made remarkable progress formalizing mechanisms by which the new GLWQA can be implemented and meeting deadlines for initial Agreement commitments.

The Commission salutes the Parties for these achievements. **To support further progress, the Commission recommends that governments' financial investment in restoration and prevention continue at current or higher levels.**

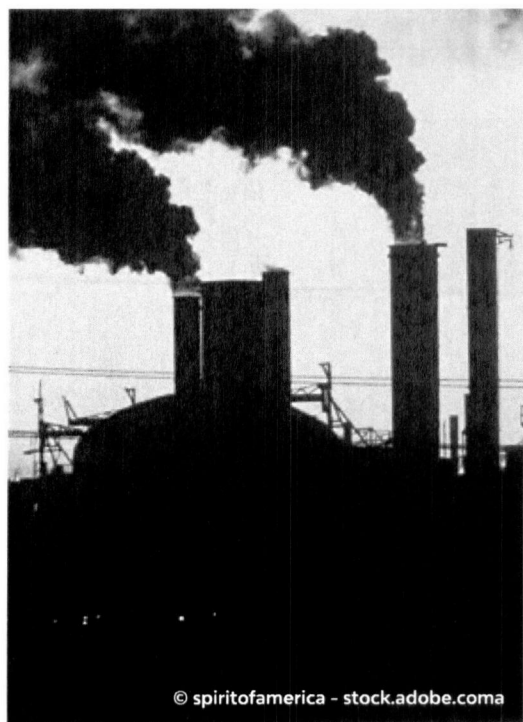
PROTECTING HUMAN HEALTH

The IJC finds that governments have not demonstrated sufficient progress toward achieving the human health objectives in their implementation of the GLWQA.

The human health objectives are those related to the drinkability, swimmability and fishability of the Great Lakes. The Parties could improve their approach to and success in addressing human health objectives by enhancing focus on objective achievement, increasing coordination among jurisdictions and improving accountability.



The Commission identified specific gaps in achieving human health objectives, including the protection and reporting of source water quality in the United States and the need for better communication of fish consumption advisories to vulnerable populations across the basin. Most importantly, the IJC finds that the continued discharge of inadequately treated and untreated sewage into the Great Lakes is unacceptable. **The IJC recommends that the Parties establish an accelerated and fixed period of time by which zero discharge of inadequately treated or untreated sewage into the Great Lakes will be effectively achieved and dedicate sufficient resources to accomplish the task.** The Parties also need to provide support to communities to proactively and systematically improve their capacity to respond to extreme storm events, especially as related to combined sewer overflows, planning, zoning and adaptation.



REDUCING POLLUTANTS

The IJC finds that progress on chemicals of mutual concern has been insufficient relative to the threat that toxic pollutants pose to the health of humans, wildlife and aquatic organisms in the Great Lakes basin. The Commission recommends that the Parties accelerate work on strategies for elimination or continual reduction of chemicals of mutual concern with clear timelines set and met for strategy development and implementation. **These strategies should have at their core the principle of zero discharge. The IJC also recommends that the Parties adopt and extend policies and programs based on the principles of Extended Producer Responsibility on a broad range of products, including flame retardants, to prevent introduction of toxic and non-toxic contaminants into the Great Lakes.**

CONTROLLING NUTRIENTS

The IJC finds that the water quality of western and central Lake Erie remains unacceptable. The Commission acknowledges the progress that has been made by the Parties, including setting phosphorus load reduction targets for the western and central basins. In particular, the IJC commends the participative approach used by the Parties for the development of these targets. However, the poor condition of Lake Erie warrants swifter action designed to achieve the targets.



The IJC recommends that the Parties further act on advice from the IJC's 2014 report on Lake Erie, most notably with respect to the need for enforceable standards governing the application of agricultural fertilizer and animal waste, along with better linkage between agricultural subsidies and farm operator use of conservation practices that are demonstrably effective at curbing phosphorus runoff. The IJC also recommends periodic testing and enforceable standards for septic systems, better stormwater management systems in urban areas and the accelerated use of green infrastructure. **Most importantly, the domestic action plans to achieve phosphorus load reduction targets must**

include details on timelines, who is responsible for actions, expected deliverables, outcomes, and quantifiable performance metrics in order to assure accountability. Finally, as recommended in the 2014 IJC report, the State of Ohio should, under the United States Clean Water Act, list its waters of the western basin of Lake Erie as impaired because of nutrient pollution. This would trigger the development of a tri-state phosphorus total maximum daily load (TMDL) involving Ohio, Michigan and Indiana, with US Environmental Protection Agency oversight. The State of Michigan has now listed its Lake Erie waters as impaired.



COMBATING INVASIVE SPECIES

Preventing the introduction of new invasive species, both aquatic and terrestrial, receives strengthened consideration in the 2012 GLWQA. **The IJC finds that there has been significant progress in preventing the introduction of aquatic invasive species to the Great Lakes.** However, continued vigilance is required to prevent new introductions. The Commission recommends the Parties require ballast water exchange

and flushing in addition to discharge treatment for seagoing vessels. The IJC also recommends that the Parties continue to devote significant resources to prevent Asian carp from invading the Great Lakes. **The Commission finds that work is required to control the spread of species that have already been introduced, in particular invasive *Phragmites*.** To address the spread of previously introduced invasive species, the Commission recommends that the Parties reach agreements on permitting the use of safe and effective control measures across all jurisdictions.

CLEANING UP AREAS OF CONCERN

The IJC finds that the first triennial cycle of the 2012 GLWQA has been a time of great progress for Areas of Concern (AOCs) with many beneficial use impairments removed in the United States and Canada and three US AOCs delisted. The IJC recommends that the Parties continue to advance implementation of remedial actions in all remaining AOCs by maintaining, or accelerating, investments and action, and setting a 15-year goal for completing remedial actions at all AOCs. The IJC also recommends enhancing public engagement through the remedial action program by creating meaningful opportunities for binational dialogue between AOC stakeholders, and supporting public advisory councils as they transition to life after delisting in their AOC.

RESPONDING TO CLIMATE CHANGE

A changing climate has been influencing the Great Lakes for some time. Further climatic change is built into the future, thanks to inexorably rising carbon dioxide concentrations in the atmosphere. The addition of a Climate Change Impacts Annex to the 2012 GLWQA represents a positive step towards addressing these issues in the basin. **However, the IJC finds that there is no Great Lakes**

basinwide perspective, approach or strategy for addressing climate change. The Commission recommends that the Parties demonstrate global leadership by jointly developing, in cooperation with other government jurisdictions, including indigenous governments, and nongovernmental organizations in the Great Lakes, a binational approach to climate change adaptation and resilience in the Great Lakes. The IJC also recommends that the Parties invest in a binational vulnerability assessment, defining the risks posed by climate change and providing technical support for measures to adapt to climate change, to engage stakeholders and all orders of government, and to identify priorities for responsive actions in the Great Lakes region, in particular recognizing the impacts of climate change on water infrastructure.





STRENGTHENING ENGAGEMENT

In the GLWQA, the Parties commit to “incorporating Public opinion and advice, as appropriate, and providing information and opportunities for the Public to participate in activities that contribute to the achievement of the objectives of this Agreement.”

The IJC finds that the Parties have not fully incorporated robust public engagement into their activities. For example, the Parties are not showing sufficient urgency in confirming their approach to public engagement and related activities for Annex 2 (Lakewide Action and Management Plans or LAMPs). Additionally, LAMP partnerships took more than three years to begin establishing their outreach and engagement work groups – after the existing committees were disbanded. Without robust

engagement, connections do not always exist between GLWQA processes and many affected communities. The Commission recommends that the Parties accelerate and deepen their approach to public engagement in LAMPs, including inbasin opportunities for participation and the use of social media and online engagement mechanisms.

The IJC also finds that the Commission and the Parties should reach beyond the limits and audiences typically recognized and should factor in consideration of environmental justice as a key objective. The Commission recommends that the Parties include more opportunities for public engagement with diverse communities and engage Tribal, First Nations and Métis governments in GLWQA implementation, incorporating greater contributions from these groups in the triennial Progress Report of the Parties.

ENHANCING ACCOUNTABILITY

The IJC finds that the Parties have substantially improved accountability under the GLWQA by implementing a three-year reporting cycle, producing the Progress Report of the Parties, and improving the selection of indicators in the State of the Great Lakes Report. However, accountability mechanisms can be further improved in subsequent cycles. Release of the Progress Report of the Parties and State of the Great Lakes report should be timed to support discussion at the Great Lakes Public Forum. **Clear, time-bound targets for action are needed as are long-term aspirations for improvements in the**

status and trends of Great Lakes indicators against which progress can be more definitively assessed. The Commission supports a comprehensive binational Great Lakes monitoring program to provide the essential information and understanding needed to forecast change, prevent or mitigate impacts, and restore and preserve the Great Lakes ecosystem.

The IJC sincerely appreciates the time, thoughts and experiences of each person who contributed to the consultation process undertaken for this report. The IJC hopes that this assessment stimulates a continued vigorous dialogue about progress and that it supports ideas and action to further strengthen Great Lakes protection and restoration.



© Soloviova Liudmyla - Fotolia



S. Nordrum (The Leech Lake Band of Ojibwe Youth Ricing)

GREAT LAKES INDIGENOUS NATIONS THANKSGIVING ADDRESS

The Great Lakes have been a site of human activity since time immemorial. We humbly ask permission from all our relatives, our elders, our families, our children, the winged ones, the four legged, the swimmers and all the plant and animal nations, to work on their behalf for the protection of the waters. We are stewards of the Great Lakes to which we are deeply connected knowing that our health as a people is intricately tied to the health of the lakes. Our first medicine is water, because life would not be possible without the blessings of the waters. The Great Lakes do not separate us. They connect us together in our humanity.

We gather in peace and honor our duty to work for the protection of the Great Lakes. We bring our minds together as one, and we give greetings and thanks to each other as relations. We acknowledge the spirit and support of our clans as we work to protect the lakes. We give thanks for when we are able to come together to speak for the waters. And we ask in a humble and a good way for everyone to have the strength and courage to carry forward the actions detailed in this report. Now our minds are one. We remember to give thanks and offer respect for all those who have gone on before us and those yet to come. And on behalf of our children, we say, with love, thank you to the waters of the Great Lakes.

Kelsey Leonard, Shinnecock Indian Nation

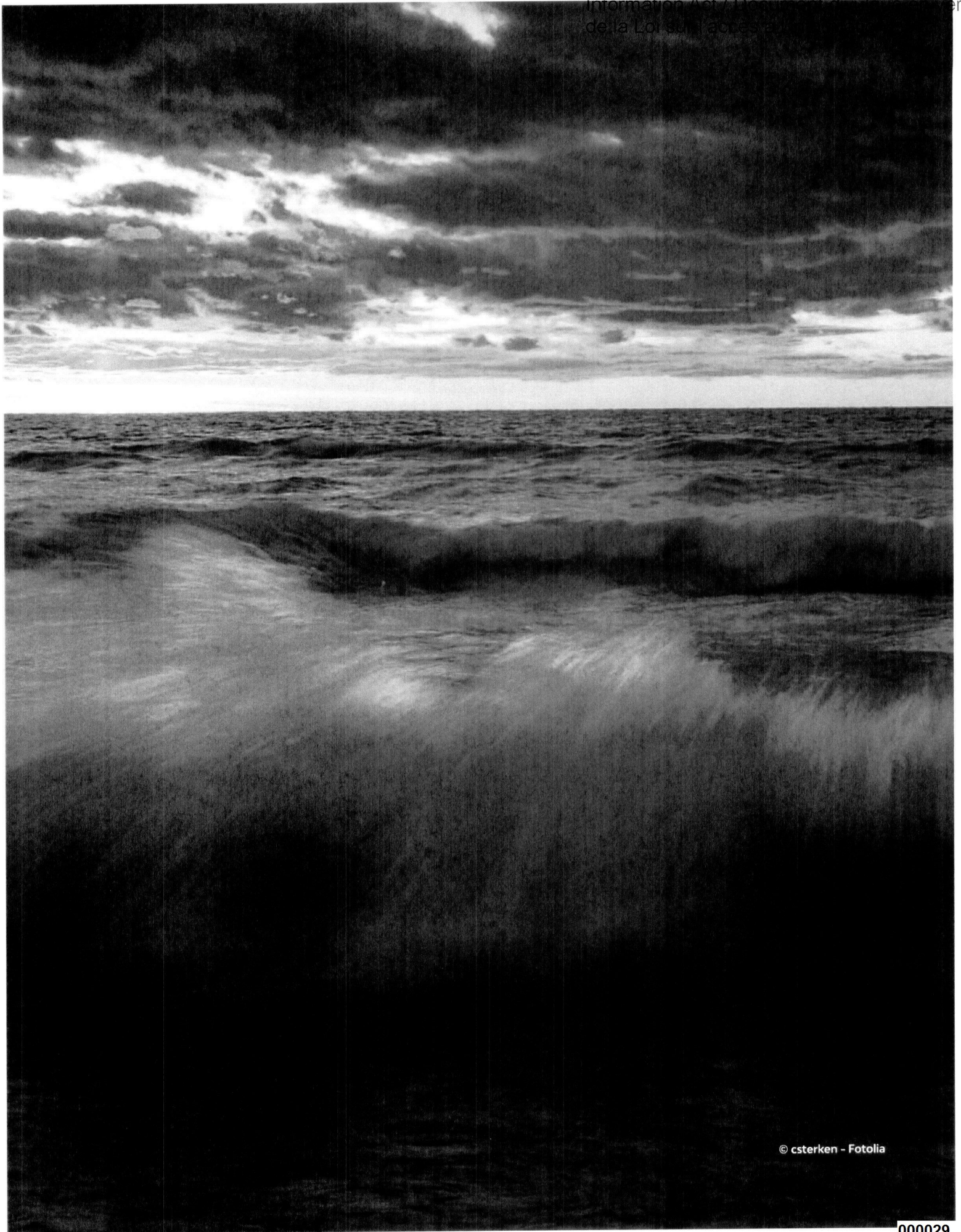


TABLE OF CONTENTS

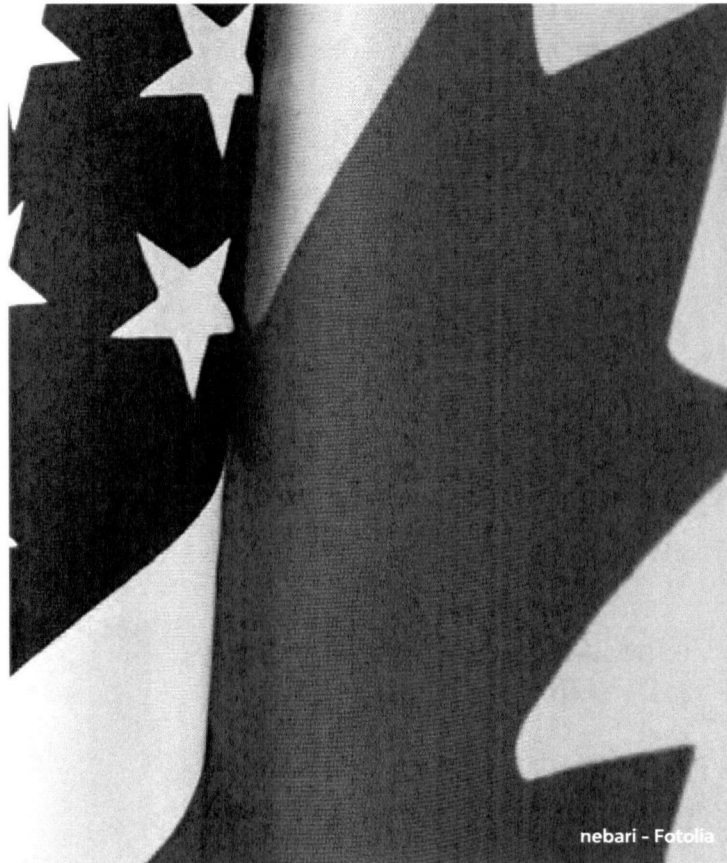
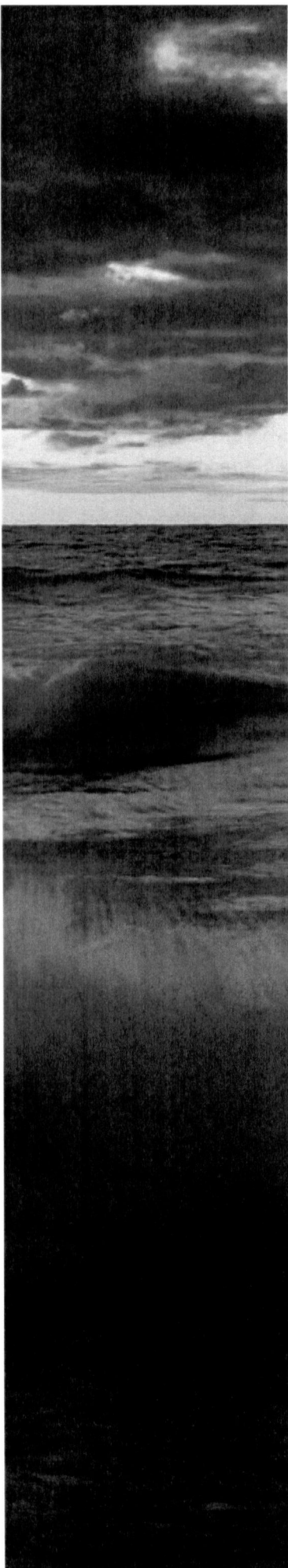
1. INTRODUCTION	23
2. A REVIEW OF THE PROGRESS REPORT OF THE PARTIES.....	29
3. SUMMARY OF PUBLIC INPUT ON PROGRESS	37
4. CONSIDERATION OF STATE OF THE GREAT LAKES REPORT	59
5. ASSESSMENT OF PROGRESS TOWARD GENERAL OBJECTIVES.....	67
1. Drinking water.....	68
2. Swimming and recreational use.....	77
3. Consumption of fish and wildlife.....	82
4. Pollutants.....	87
5. Wetlands and other habitats	95
6. Nutrients.....	100
7. Invasive species	109
8. Groundwater	120
9. Other Materials, Substances and Conditions	124
6. ADVICE ON CRITICAL ISSUES.....	135
1. Implementation of the 2012 Agreement	136
2. Human Health.....	137
3. Climate Change	143
4. Engagement.....	150
7. FINDINGS AND RECOMMENDATIONS.....	157
8. List of Acronyms, Figures and Glossary	170
List of Figures	170
List of Acronyms	171
Glossary	172

Technical Appendix

Summary of Public Comment Appendix



© csterken - Fotolia



nebari - Fotolia

1.

INTRODUCTION

The International Joint Commission (IJC or Commission) is a binational organization created by Canada and the United States in the *Boundary Waters Treaty of 1909* (the Treaty). Under the Treaty, the two countries cooperate to prevent and resolve disputes relating to the use and quality of many lakes and rivers along their shared border. The Great Lakes Water Quality Agreement (GLWQA or Agreement) assigns the IJC an independent advisory role in assessing progress, engaging the public and providing scientific and policy advice to help the two countries restore and maintain the chemical, physical and biological integrity of the waters of the Great Lakes.

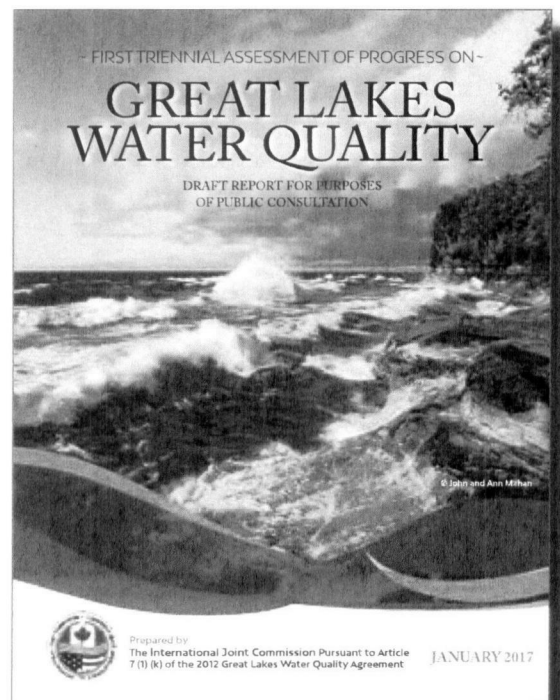
This report is the IJC's first triennial assessment of progress under the authority of the 2012 Protocol to the GLWQA. Article 7.1 (k) of the Agreement specifies that the IJC's triennial "Assessment of Progress Report" is to include:

- (i) a review of the Progress Report of the Parties (PROP)
- (ii) a summary of public input on the PROP
- (iii) an assessment of the extent to which programs and other measures are achieving the General and Specific Objectives of the GLWQA
- (iv) consideration of the most recent State of the Lakes (SOGL) Report, and
- (v) other advice and recommendations, as appropriate.

This triennial report replaces the IJC's previous biennial reporting cycle on Great Lakes Water Quality. The IJC issued the last biennial report, the 16th, in 2013. Anticipating the 2012 GLWQA, the 16th Biennial Report assessed progress under the Agreement from 1987 to 2012 and marked the return to undertaking a more comprehensive assessment. This last biennial report used seven indicators of chemical integrity, five indicators of biological integrity, two of physical integrity, and two performance indicators to assess progress over the 25-year period ending in 2012.

In this report, the IJC presents a review of the PROP (Chapter two), a summary of public input (Chapter three) and considers the most recent SOGL report

(Chapter four). The Commission also assesses the extent to which programs and measures are achieving GLWQA objectives based on its own review and information in the PROP and SOGL reports (Chapter five), and provides advice on critical issues (Chapter six). The assessments presented in these chapters are supported by a substantive Technical appendix that provides supporting information and more detailed analysis. The report concludes with findings and recommendations (Chapter seven). At the end of the report, a list of acronyms and a glossary are provided.



Cover of the draft report of the first Triennial Assessment of Progress on Great Lakes Water Quality by the International Joint Commission, January 2017.

REPORTS REQUIRED BY THE GREAT LAKES WATER QUALITY AGREEMENT

Progress Report of the Parties (PROP)

This report documents actions relating to the Agreement, taken domestically and binationally, by the US and Canadian governments. PROP is to be issued before each triennial Great Lakes Public Forum.

State of the Great Lakes Report (SOGL)

Also issued triennially, this report provides data on progress towards achieving the overall purpose of the Agreement to restore and maintain the physical, chemical and biological integrity of the Great Lakes Basin Ecosystem through reporting on ecosystem conditions and trends. It is a report on ecosystem conditions, rather than actions and programs of the governments, which are covered in PROP.

Triennial Assessment of Progress Report (TAP)

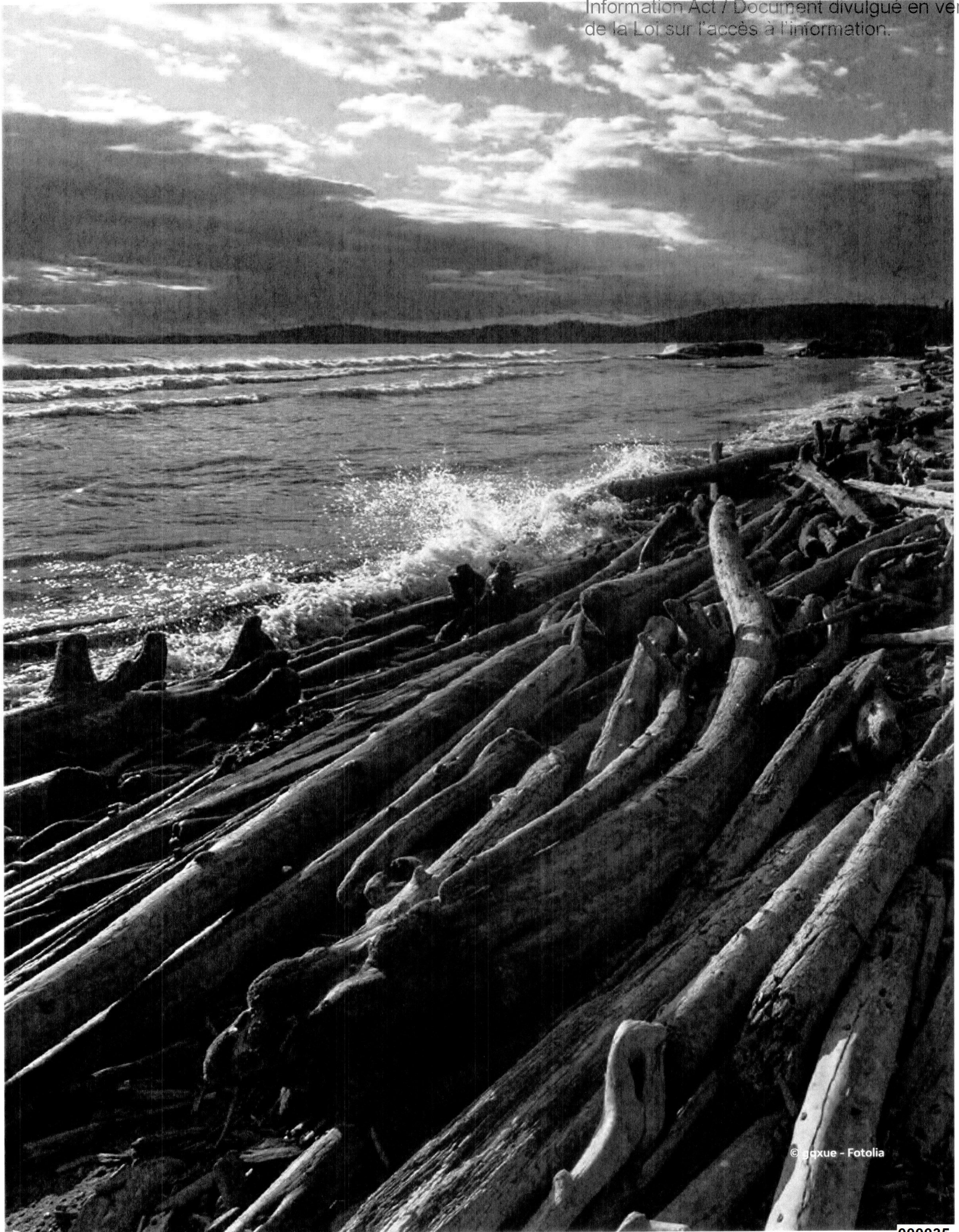
The Agreement requires the IJC to prepare and submit to the governments a report that reviews PROP, summarizes public input on PROP, assesses the extent to which programs and other measures are achieving the General and Specific Objectives of the Agreement, considers the most recent SOGL and provides other advice and recommendations, as appropriate.

The recommendations in this report are based on the Commission's best judgment and are informed by input from the IJC's Great Lakes advisory boards. This report was written considering the vast array of input received from the public, including public comments on the PROP and on the [January 2017 draft of this report](#). A record of the public input received is provided in the [Summary of Public Comment](#) appendix that supplements this report.

In this Triennial Assessment of Progress (TAP) report, assessment of programs and measures in chapter five is organized by the nine general objectives set out in the GLWQA. This is in contrast to the organization of the PROP, which documents government actions relating to the Agreement for each of its annexes. Organizing this assessment by objectives is consistent with the charge to the IJC under the GLWQA and how the Parties presented their most recent SOGL report.

One of the laudable features of the GLWQA is its inclusion of 16 guiding principles and approaches, ranging from accountability to zero discharge. The IJC has rendered its assessment with these principles and approaches in mind. In particular, the Commission supports the approach of prevention, which the GLWQA defines as “anticipating and preventing pollution and other threats to the quality of the Waters of the Great Lakes to reduce overall risks to the environment and human health.” An emphasis on prevention would have forestalled some of the most serious harms the Great Lakes ecosystem has suffered, such as the introduction of the zebra mussel, which was known to be a threat years before its arrival. The IJC is optimistic that adherence to the GLWQA’s guiding principles and approaches will foster healthier and more resilient Great Lakes.

The IJC hopes that this assessment stimulates a continued vigorous dialogue about progress and that it supports ideas and action to further strengthen Great Lakes protection and restoration.

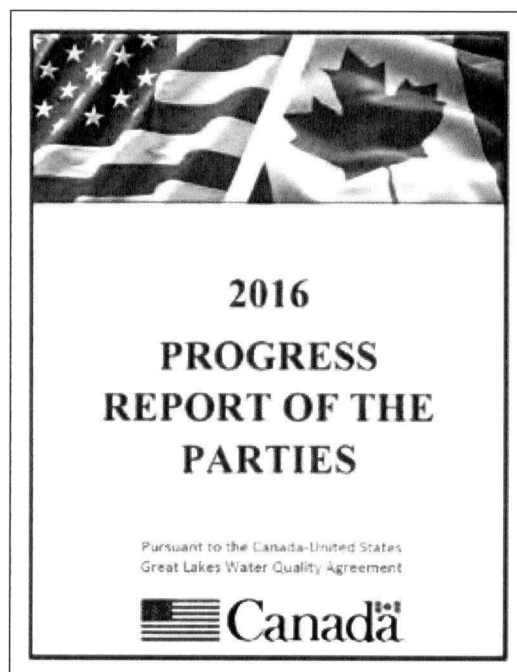


© gpxue - Fotolia

2.

A REVIEW OF THE PROGRESS REPORT OF THE PARTIES

The GLWQA requires that the IJC's triennial assessment of progress include a review of the Progress Report of the Parties (PROP), produced by the governments of Canada and the United States as Parties to the GLWQA. This chapter assesses the quality of the PROP in meeting reporting requirements and demonstrating implementation of the principles and approaches established in Article 2.4 of the GLWQA that are relevant to reporting. The full list of reporting requirements and applicable principles and approaches is found in the Technical Appendix, along with a more detailed review of the PROP.



Cover of Progress Report of the Parties released September 28, 2016 by the governments of Canada and the United States.



The production of the PROP is a new commitment by the Parties under the 2012 GLWQA. It and the IJC review of the report are key government accountability features. The IJC commends the Parties for adding these accountability mechanisms in the Agreement and for their implementation.

A key reporting requirement for the PROP is set out in Article 5.2 (e) of the GLWQA, where it states that the PROP is to document actions taken domestically and binationally in support of the Agreement. The PROP accomplishes this with a clear and readable catalogue of actions related to the articles and annexes, and also addresses each of the specific reporting requirements identified in the annexes.

Under the GLWQA, the Parties commit to publicly reporting in the PROP, SOGL and lakewide action and management plans (LAMPs) on progress in achieving the Agreement's objectives. The PROP does not significantly discuss progress relative to the GLWQA's general objectives, and the Parties

have not yet established specific objectives for lake ecosystems or substances, except for phosphorus in Lake Erie. Progress relative to GLWQA's general objectives is the focus of the SOGL 2017 reports that describe changes in indicator levels relative to each objective. However, although the PROP was published on September 28, 2016, the SOGL Highlights report was not published until June 2017. The SOGL technical report was not published until September 2017, almost a year after the PROP. The PROP and SOGL reports relate very closely to each other and coordinated release of these reports in the future would better enable a review of the actions presented in the PROP in comparison to the indicator levels associated with each of the objectives. Having access to the most current SOGL is essential to fully review the progress of governments in GLWQA implementation.

GLWQA principles and approaches relevant to the review of reporting in the PROP are accountability, adaptive management, coordination, and public engagement.

ACCOUNTABILITY

The first principle is accountability, defined in the GLWQA as establishing clear objectives; regularly reporting on progress to the public; and evaluating, in a transparent manner, the effectiveness of work undertaken to achieve the Agreement's objectives. The general objectives are important for continuing and ongoing work on the Great Lakes; however, they give limited insight into the particular implementation goals and management actions for an individual three-year work cycle.

Other possible targets against which the progress of the governments could be measured include commitments made in the 2012 GLWQA and the priorities for science and action that the governments are required to develop under Article 5.2 (Consultation, Management and Review). The PROP reports on commitments, which is most effective where commitments are specific and time-bound. In cases where commitments are more general, assessment of the appropriateness of the extent, depth and timing of the task undertaken is more problematic for the public and the IJC to evaluate.

YOUR VOICE

"We would like to applaud the effort to have regular Progress Reports of the Parties as well as State of the Great Lakes reports preceding these triennial reviews. As these reports are revised and updated, it will be important to clarify the intent of each report, the organization of each document and the manner by which the public should comment and engage on the content."

Healing Our Waters-Great Lakes Coalition,
comment via email, April 14, 2017

Priorities for science and action that are set by the Parties at the beginning of each triennial cycle offer additional targets against which to measure progress. The PROP would have benefitted from addressing priorities set for 2014-2016 as directly and

clearly as the time-bound commitments in the GLWQA. On the implementation of the chemicals of mutual concern (CMC) annex, for example, the PROP fails to mention that progress falls well short of the annex's 2014-2016 priorities for action, which included the development of binational strategies for the first set of CMCs by summer 2015. Draft strategies for only two CMCs have been developed as of the publication of this report in autumn 2017. However, to effectively fulfill the role of setting targets for a work cycle and improve accountability, the priorities for science and action must be well defined and show how actions are being prioritized within and between objectives and annexes. Unfortunately, the Parties' 2017-2019 priorities for science and action do not incorporate a sufficient number of specific targets for proposed activities, including no specific targets for implementation of the CMC annex.

If the PROP is to be sustained as an accountability mechanism under the GLWQA, reporting on near-term targets in the priorities for science and action will become increasingly important. The number of GLWQA commitments with specific deadlines declines sharply after this first work cycle. Apart from one further time-bound requirement regarding the development of phosphorus reduction strategies and domestic action plans for Lake Erie, only general and cyclical commitments remain. These include triennial reporting and priority setting processes and the requirement to produce a LAMP for each Great Lake every five years.



The SOGL report can also be used as a mechanism for setting targets for accountability. These targets would be longer-term aspirations for changes in the trends or status of indicators. The importance of these types of targets is that they would relate to the actual status of the lake as opposed to the implementation of management actions, and would be longer term since it takes time for management actions to be evidenced in the status of the lakes.

The IJC recommendations in this report provide further targets against which the progress of the Parties in implementing the GLWQA can be assessed. The Parties should report progress relative to these recommendations in future rounds of PROP reporting.

ADAPTIVE MANAGEMENT

In the GLWQA, adaptive management is defined as implementing a systematic process by which the Parties assess effectiveness of actions, and adjust future actions to achieve the Agreement objectives as outcomes and ecosystem processes are better understood. The PROP paints a very positive picture of GLWQA implementation. Although that picture is often justified, transparency would be served and the report would be more accurate if it included discussion of where past or current programs have fallen short of expectations. This discussion would give the governments the opportunity to show how they are implementing an adaptive management approach to achieve the objectives of the GLWQA over time.

COORDINATION

Coordination is defined in the GLWQA as developing and implementing coordinated planning processes and best management practices by the Parties, as well as among state and provincial governments, tribal governments, First Nations, Métis and municipal governments, watershed management agencies, and local public agencies. The PROP demonstrates that the Parties are implementing the principle of coordination with federal, state and provincial bodies. There is broad engagement by departments and agencies – listed in the report – that are contributing to the various annex committees. However, coordination beyond these bodies is less clear. Some annex committees, notably Annexes 2 (Lakewide Management) and 6 (Aquatic Invasive Species), have broad and varied composition. Others, for example, Annexes 3 (Chemicals of Mutual Concern), 8 (Groundwater), and 10 (Science), have predominantly, if not exclusively, government membership.



The Annex 6 subcommittee is most notable with respect to coordination in that it has a reasonably broad membership, including Tribal and First Nations organizations, a municipal organization and two nongovernmental organizations in addition to federal, state and provincial governments. It also works in close cooperation with the Great Lakes Panel on Aquatic Nuisance Species that has its own broad, binational membership. The Parties could demonstrate wider coordination and engagement if, as per Annex 3, details of the extended subcommittee were provided in the PROP report or on the binational.net website. The Parties could also show stronger evidence of coordination in the PROP through greater inclusion of binational and domestic actions conducted by a larger range of organizations.

Looking specifically at coordination with indigenous governments, the PROP does not paint a satisfactory picture. Only five different indigenous governments or organizations are listed by name as members of annex committees and only four annex subcommittees have representation from these groups. The lists of binational and domestic actions only include three projects that mention indigenous involvement.

PUBLIC ENGAGEMENT

Public engagement is defined in the GLWQA as incorporating public opinion and advice, as appropriate, and providing information and opportunities for the public to participate in activities that contribute to the achievement of Agreement objectives. In future rounds of reporting, the Parties should improve the PROP in content and delivery in

order to serve as an effective tool for public engagement. The PROP could include relatable case studies and more pictures and graphics to make it more compelling for readers. For the purpose of public engagement, the Parties should release the PROP publicly at least one month prior to the Great Lakes Public Forum, the triennial event that provides a key opportunity for the Parties to discuss and receive public comments on the state of the lakes and binational priorities, and for the IJC to receive input on the PROP. The Parties should also promote the PROP extensively throughout the basin using a variety of traditional and social media and use the

report at the Forum as the centerpiece for the presentations on annex implementation. Release of the SOGL report prior to the Forum, in coordination with the PROP, would further advance and improve public engagement and understanding of the status of Great Lakes water quality.

The lack of promotion of the PROP to the public by the Parties was clearly evident by the lack of awareness of the report at the public engagement sessions held by the IJC, and the scant mention of the PROP by the public during the Commission's call for public input.



IJC (Detroit meeting)

CONCLUSION

The PROP is a clear, readable catalogue of actions. Overall, the PROP in itself represents a large step forward in accountability under the GLWQA. However, coordinated release of the SOGL report with the PROP is essential in order to conduct a proper assessment of governments' progress. Accountability would be further improved over time with the addition of clear, specific, time-bound commitments for implementation goals and management actions. The report would also benefit from a more critical evaluation of the effectiveness of programs and measures by the Parties themselves, a greater demonstration of coordination outside of federal, state and provincial agencies, particularly with indigenous governments, and greater focus on and communication of the PROP as a public engagement tool.

RECOMMENDATIONS

To further improve reporting, the IJC recommends that:

- The Parties set clear, time-bound targets for action and also longer-term aspirations for improvements in the status and trends of Great Lakes indicators as measured by science-based indicators.
- In future reporting cycles, the Parties coordinate the timing of the Progress Report of the Parties and the State of the Great Lakes report and release the reports sufficiently before the Great Lakes Public Forum to ensure informed discussion at the Forum.
- The next Progress Report of the Parties, expected in 2019, and those following include reporting on how the recommendations in this triennial assessment of progress are being addressed.



IJC (Buffalo meeting)



3.

SUMMARY OF PUBLIC INPUT ON PROGRESS

The IJC believes strongly that public engagement is the foundation of effective public policy and that achieving the Great Lakes Water Quality Agreement's (GLWQA or Agreement) purpose and goals will only happen if all sectors of the Great Lakes community are involved. Because of this belief, and the fact that Article 7 of the GLWQA requires the Commission to consult on a regular basis with the public, increase awareness of the lakes' inherent value, and prepare a summary of comments on the Progress Report of the Parties (PROP), the IJC conducted several public engagement activities as part of its triennial assessment of progress under the GLWQA. Input was received at thirteen public meetings, roundtables and listening sessions, through the IJC's online democracy platform, Participate IJC, and its newsletters, social media and website, and via email and mailed letters.

Public engagement responsibilities assigned to the International Joint Commission in Article 7

The Parties agree that, pursuant to Article IX of the Boundary Waters Treaty, the Commission shall have the following responsibilities:

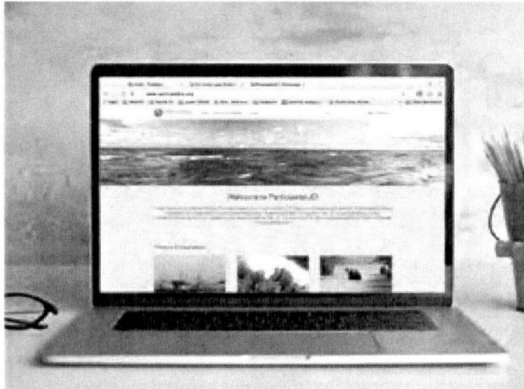
1. (g) consulting on a regular basis with the Public about issues related to the quality of the Waters of the Great Lakes, and about options for restoring and protecting these waters, while providing the Public with the opportunity to raise concerns, and tender advice and recommendations to the Commission and the Parties;
(h) engaging with the Public to increase awareness of the inherent value of the Waters of the Great Lakes, of the issues related to the quality of these waters, and the benefit of taking individual and collective action to restore and protect these waters;
(k) providing to the Parties, in consultation with the Boards established under Article 8, a triennial "Assessment of Progress Report" that includes:
 - (ii) a summary of Public input on the Progress Report of the Parties;"

Four meetings were held in fall 2016 – the public comment session at the Parties' Great Lakes Public Forum in Toronto, two public meetings in Toronto, Ontario and Milwaukee, Wisconsin and a scientific roundtable in Milwaukee – to obtain input on the PROP report as well as participants' perceptions of progress to restore and protect the lakes. Nine additional sessions were held in March 2017 in six communities around the basin to hear what people felt about Agreement progress as well as the IJC's draft assessment report. In total, more than 1,000 people participated in these sessions.

Each meeting was unique in its design to provide a variety of opportunities for participants to comment on the PROP and the IJC's draft report, to learn about local and regional innovative programs addressing Great Lakes issues, and to provide their

thoughts about the status of Great Lakes water quality. Their comments reflect the specific perspectives and priorities of each community, reinforcing the adage that we may think globally but we are most likely to act locally about the issues that most affect our individual lives. At the same time, some also discussed issues that impact the entire watershed and illustrate the need for an ecosystem approach to Great Lakes management.

Videos of these sessions were uploaded to Participate IJC, an online democracy tool that provides detailed information and opportunities for input and dialogue on various IJC initiatives, including activities under the GLWQA. This tool allows people to record their comments on the website and also to view other people's comments and presentations made at the public meetings.



The IJC actively promoted and reported on these events through its newsletters and traditional and social media. It invited comments on progress to restore and protect the lakes via email and letters from October 5, 2016 to April 15, 2017, which were received from individuals, nongovernmental

organizations from all sectors of society, and from municipalities and other governments in addition to the oral comments given at the public meetings. All oral and written comments, letters, articles and other correspondence have been considered carefully in preparing this final report.

Each person's input throughout this GLWQA assessment process as well as summaries of each public meeting, which illustrate the unique issues and perspectives relevant to those communities, are included in the Summary of Public Comment Appendix to this TAP report. The IJC sincerely appreciates the time, thoughts and experiences each person contributed to this consultation process, and their dedication to the health of the Great Lakes.



© Stanislav Komogorov - stock.adobe.com

THEMES AND ISSUES RAISED DURING THE PUBLIC CONSULTATION PROCESS



Public Meetings

Before the Commission traveled around the basin to hear from the public, it coordinated with local experts, governments and organizations to organize meetings that focused on issues most relevant to their community and region. Most meetings were designed so participants could divide into small groups to develop recommendations on key issues. In larger meetings the sessions focused on brief presentations and providing ample time to hear everyone's views. While complete summaries of each meeting's discussions and recommendations are available in the [Summary of Public Comment Appendix](#), highlights of the themes and key issues at each public session are highlighted here.

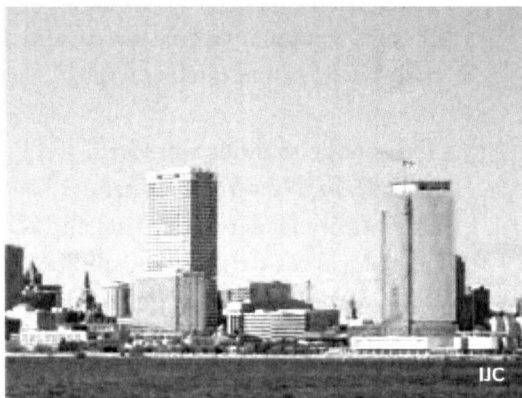
- In **Toronto**, the evening public meeting focused on waterfront regeneration, the area's remedial action plan, wastewater treatment and particularly combined sewer overflows, toxic substances, and fish habitat. During the IJC's public comment session at the Great Lakes Public Forum, statements reflected a variety of topics, including climate change, indigenous rights, reductions in nutrient loads into Lake Erie, nuclear waste, storage and transport, radionuclides, protecting natural heritage, wetlands preservation, and public engagement in Great Lakes issues.

YOUR VOICE

"It's the most important thing to the people of the Great Lakes when they come to you expressing their concerns when they can't drink the water or they can't eat the fish or go swimming. We have to do a better job of reflecting that and letting them know that they are heard and ... engaging them to go ahead and act individually."

Mark Mattson, Lake Ontario Waterkeeper, IJC
public comment session at the Great Lakes
Public Forum, Toronto, Ontario, October 5, 2016

- **Milwaukee's** public meeting addressed green infrastructure, the Milwaukee Metropolitan Sewerage District's 2035 vision and goals, the Watercentric Cities Initiative to develop regional management plans that focus on the water resource, citizen-based water monitoring, nutrient reduction and aquatic invasive species in Lake Michigan, and consideration of the latest Waters of Wisconsin report.



- At an afternoon listening session with members of First Nations and Tribes in **Sault Ste. Marie, Ontario** and at an evening public meeting, topics raised were wastewater infrastructure, the St. Marys River fisheries habitat project as part of that area's remedial action plan, the Lake Superior Water Trail, the history and role of First Nations and Tribes in Great Lakes management and protection, toxic contamination, aquatic invasive species and climate change. Also emphasized were threats to the safety and health of the ecosystem from the Enbridge Line 5 pipeline and from the proposed Deep Geological Repository for low and intermediate level radioactive waste near Lake Huron in Kincardine, Ontario.
- In **Detroit, Michigan**, afternoon roundtable and evening session participants focused on the swimmability, drinkability, and fishability of regional Great Lakes beaches and waterways, water infrastructure needs and equitable funding. Participants discussed public access to the water, public engagement including how best to coordinate and

communicate data and notify people about beach closures, and stormwater and agricultural runoff management strategies. Issues related to industrial pollution, energy production and transport, radionuclides and nuclear power, and binational coordination for the Detroit River Area of Concern were also raised.

- At the afternoon public session in **Sarnia, Ontario**, attendees discussed the successes and challenges in restoring the St. Clair River Area of Concern, chemicals of mutual concern in air and water and their effects on human health, dredging, controls on agriculture to reduce nutrients, controls for invasive species such as the plant *Phragmites*, the role of indigenous communities in Great Lakes protection, and nuclear waste.



YOUR VOICE

"I am a mother who brought her daughter with me tonight. This has been a tremendous education for both of us. My parents were farmers, when I was young we saw frogs and bees everywhere. We don't see either anymore. Our children will remember what we do. Please be active and consider this a personal mission to protect our earth."

Elizabeth Uhlik, Public Meeting on the Great Lakes, Toledo, Ohio, March 23, 2017

- **Toledo, Ohio's** public meeting focused almost exclusively on how to control nutrients entering Lake Erie that create harmful algal blooms. Specific topics related to this issue included the effects of using animal waste as fertilizer and other nonpoint sources of nutrient pollution, impacts on drinking water and beach closures, progress to restore the Maumee River Area of Concern, and habitat and wetlands restoration. Other issues raised were climate change, aquatic invasive species, and radionuclides and nuclear waste.
- Two public sessions were held in **Buffalo, New York**, where community leaders, scientists and other local residents talked about the accomplishments, challenges and further actions needed to restore and protect the Buffalo-Niagara region of the Great Lakes, including

the Buffalo River Area of Concern, wetlands restoration and protection, and recreation as an essential element in economic development strategies. Other themes at the two meetings included a holistic approach to water quality, community education and engagement, and developing plans to deal with combined sewer overflows and with radionuclides from nuclear waste facilities.

- At the **St. Catharines, Ontario** meeting, presentations summarized progress to improve the water quality of the Grand River and Lake Ontario, reduce nutrient runoffs by practicing sustainable and precision agriculture, and restore the Niagara Area of Concern. Participants also raised issues such as the lack of beach or water access and beach closures, microplastics, combined sewer overflows, nuclear waste transport, and the terrestrial invasive species, *Phragmites*.

Written Correspondence

Individuals, nongovernmental organizations, industry associations and municipal governments provided a wealth of additional input in written correspondence via email, letter and on the online democracy website, Participate IJC. As with comments made at the public meetings, the letters and emails reflect a deep appreciation for Great Lakes waters as a precious resource, their concern for the lakes' health and future, and a collective commitment to contribute to their restoration and protection.

Six topics were raised more than others in letters from individuals. Concerns for nuclear energy production, waste storage and transport were prevalent, as well as for toxic contamination, safe drinking water, the effects of nutrients from agricultural runoff and other sources to the lakes, threats and impacts from aquatic invasive species – particularly Asian carp – and from climate change. Other issues raised frequently were harmful algal blooms, possible cuts to US funding for Great Lakes restoration, combined sewer overflows, and progress to restore Areas of Concern.



The wide variety of nongovernmental organizations that represent Great Lakes residents and businesses – with combined membership of more than a million people – also focused their comments primarily on the same six issues raised by individuals. For toxic contamination, organizations cited the Agreement's requirement for governments to identify and control chemicals of mutual concern. They also recommended actions needed to advance Lakewide Action and

Management Plans and restoration efforts in Areas of Concern. Several groups identified concentrated animal feeding operations, or CAFOs, as a key source of nutrients to the lakes. The organizations focused their comments on these and other issues in terms of successful and additional actions needed by governments to implement accountable, enforceable programs and actions that accomplish the goals and objectives of the GLWQA.

TOPICS OF PUBLIC CONCERN

Seventy topics were raised by the public. A complete list is available in the [Summary of Public Comment Appendix](#). The top 25 topics by frequency of mention throughout the TAP public engagement process are included here.

Top 25 Topics of Public Concern

1. Safe drinking water (drinkable)
2. Recreation and tourism (swimmable, fishable)
3. Nuclear plants/nuclear waste
4. Proposed Lake Huron nuclear waste repository
5. Toxic contamination and other pollutants
6. Proposed US funding cuts to Great Lakes programs
7. Radionuclides as a chemical of mutual concern
8. Nutrients, agricultural runoff and best management practices
9. First Nation/Tribe/Métis involvement
10. Infrastructure and wastewater treatment plants
11. Draft TAP report content and findings
12. Citizen activism, public participation and education
13. Areas of Concern
14. Enbridge Line 5 pipeline
15. Climate change
16. Mandatory regulations for concentrated animal feeding operations
17. Aquatic invasive species
18. Harmful algal blooms
19. Asian carp
20. Safe beaches/closures
21. Combined sewer overflows
22. Environmental justice
23. Ballast water controls
24. Lack of government action/mismanagement
25. Nestlé/bottled water withdrawals

Input received on these and other topics are organized in the rest of this chapter by the themes that emerged throughout the consultation process and as they relate to the Agreement's general objectives. Not all issues raised by the public fall under the ambit of the GLWQA, but in virtually all cases they do impact the health of the Great Lakes or the people who live in the basin. The views expressed in the following sections of this

chapter are those of participants in the IJC's consultation process and not necessarily the Commission, but were taken into account as this report and its recommendations were finalized. Given the importance and value of this input, all comments are included in the Summary of Public Comment Appendix, where specific attribution to the issues summarized below is provided.

Objectives 1, 2, and 3: Drinkable, Swimmable, Fishable

Great Lakes residents connect to the lakes according to where they live and how they can or cannot use and enjoy them. Their desires for safe drinking water, safe beaches for recreation and tourism, and fish safe to eat were prominent themes throughout all meetings as well as in individual letters and emails.

Safe Drinking Water

Throughout the Great Lakes region, the public overwhelmingly felt that clean, safe drinking water should be the highest priority. The emergencies in Toledo in 2014 and in Flint, Michigan starting in 2015, gave them clear evidence of this reality. Infrastructure improvements in wastewater treatment and especially combined sewer overflows are crucial, particularly in urban areas. Consistent regulations and regional plans for sewage discharge are needed across the states and provinces to deal effectively with this basinwide issue.

Some people and organizations want geographic breakdowns of drinking water quality rather than generalized data across

entire lake basins that make this indicator appear rosier than what they feel is actually occurring. Several Great Lakes organizations and an Ontario municipality noted that source water quality is reported on in Canada while in the United States only the quality of drinking water after treatment is reported. The United States lacks a national database for the quality of source water used as a public drinking water supply. These and other commenters felt such measures should be identical in both countries to ensure parity in drinking water quality and to effectively assess progress to meet the Agreement's objective that "the waters of the Great Lakes be a source of safe, high quality drinking water."



YOUR VOICE

"I urge you to protect the Great Lakes as a source of safe, fresh drinking water for present and future generations by mandating source water protection plans. Ensuring public health will help not only the local residents who depend directly on the lakes for drinking water but will ensure a thriving outdoor recreation industry."

Petition via email from 56 New York residents,
April 4-9, 2017

Several individuals and representatives of municipal governments and nongovernmental organizations said that public education is essential to engage communities in local and regional drinking water and recreation issues. Residents need to learn how water is treated, where to access information about the quality of their drinking water, how to recognize sewage overflows and contact authorities. Residents also need to know how to participate in decisions about infrastructure improvements and support development of green infrastructure, which was proposed as often more cost effective than traditional water treatment options.

By visiting several Great Lakes communities, the IJC also learned about innovative municipal efforts to protect and restore water quality. In Milwaukee and Toronto, for example, respective Watercentric and One Water approaches are helping communities to develop water

use and conservation plans that encourage resource stewardship by governments and residents, address distribution and equity issues, provide funding incentives and options for aging infrastructure, and create new technologies to encourage green infrastructure and environmental sustainability. In other communities, major investments in stormwater collection and green infrastructure are reducing untreated runoff and increasing resilience against more extreme rainfall events.

People in urban communities such as Detroit and Milwaukee raised concerns about access to clean drinking water due to issues of affordability, treatment and distribution. Residents in Sault Ste. Marie, Sarnia, and Detroit also expressed the view that corporations are allowed to extract water for further distribution at a cheaper rate than residents pay for treated water.

Safe Water for Recreation and for Fish and Wildlife Consumption

Opportunities to swim, fish and enjoy other water-based recreation are key concerns throughout the basin, and many commenters do not feel that governments adequately focus restoration efforts to reflect these important benefits of the lakes. However, some people remarked that many beaches are now open where swimming would not have been considered safe 20 years ago due to the quality of the water. Sewer bypass and overflow discharges continue to impact water quality and recreation opportunities in large urban centers as well as small shoreline communities. Many people want infrastructure improvements and consistent,



basinwide sewage discharge regulations that ultimately will eliminate sewage discharges and increase green infrastructure to capture stormwater and protect recreational water uses. In the interim, several people in Toronto and Milwaukee said effective advance communication is essential to warn residents of combined sewer overflows and that they should know how to report sewage discharges to authorities.

YOUR VOICE

"I've fished and boated in Lake Erie for more than 70 years. We must push harder to help the sewer authority eliminate combined sewer overflows and reduce pollution runoff. These efforts must be funded."

Richard Smith, Public Meeting on the Great Lakes, Buffalo, New York, March 28, 2017

Many people at the public meetings in Toledo, St. Catharines, Detroit and Buffalo said that consistent basinwide rules for beach

advisories and closings and fish advisories are also needed, which should be used to track trends in specific locations where swimming or fishing is not allowed regularly. One joint project mentioned by government researchers between US EPA, the US Geological Survey's Great Lakes Observing System and Wisconsin Sea Grant holds promise to predict real-time water quality conditions and increase the accuracy of beach closure notifications. People living around Lake Erie and Lake Ontario, particularly Toronto, believe that both types of advisories must be communicated more broadly in affected communities using a wide variety of traditional and social media methods.

Participants in the Detroit roundtable session discussed the linkages between human health, quality of life and Great Lakes water quality. Several felt that social science indicators should be created that measure how and when people can and cannot use Great Lakes waters for recreation, and that reflect quality of life for Great Lakes communities. These might include rates and locations of combined sewer overflows, frequency and location of

harmful algal blooms, beach availability and fish advisories, just as biological indicators are used to measure ecosystem health. In addition, several people at this and other meetings and through letters from nongovernmental organizations noted that an Agreement annex dedicated to human health, or a human health committee to specifically address the objectives of drinkable, swimmable and fishable waters, is needed to develop and track specific programs and progress.

Finally, people from communities throughout the Great Lakes region recommended that increased public access to natural shorelines be a planning goal in all waterfront

communities. This will help communities to recognize the growing role and economic value of tourism, as well as the role that safe and easy access plays in fostering stewardship for the lakes. They said that people need to directly experience the Great Lakes to appreciate their intrinsic value, through boating, fishing and swimming in open waters, and picnicking, hiking and bicycling along their shores. Initiatives such as the Great Lakes Waterfront Trail and the Lake Superior Water Trail were enthusiastically discussed in Toronto and Sault Ste. Marie, respectively, as gateways to learn about the lakes and develop emotional connections to the watershed.

Objective 4: Water Free from Pollutants

Legacy, New and Emerging Toxic Contaminants

“Please do everything you can to make and keep the Great Lakes free of chemicals and toxic pollution.” This emailed statement from Karin Sletten-Farjo was echoed strongly throughout the basin for legacy, new and emerging contaminants. While some people recognized the significant steps that have been taken over the past 30 years to control and eliminate direct inputs of persistent toxic substances by governments and industry, particularly in Areas of Concern, many people and nongovernmental organizations doubt that current monitoring, control and prevention actions are adequate to preserve public health and the environment – let alone uphold the GLWQA’s principle of the virtual elimination of persistent toxic substances.

For example, some commenters said that data is not reported accurately or on a timely basis and is not widely available to the public to understand actual levels of toxic substances released into the lakes from point and nonpoint sources, such as the atmosphere, mining and hydrofracking activities, current and legacy industrial sites, urban stormwater runoff and groundwater. Public awareness of emerging contaminants such as pharmaceuticals in wastewater, flame retardants and microplastics – including microbeads found in personal care products, decaying plastics, and fibers from clothing – has grown because of recent studies and new detection technology. Many meeting participants called for increased research to identify sources and impacts as well as controls and prevention strategies for these emerging

contaminants, which they believe may cause adverse effects in fish, wildlife and humans even at extremely low levels.

YOUR VOICE

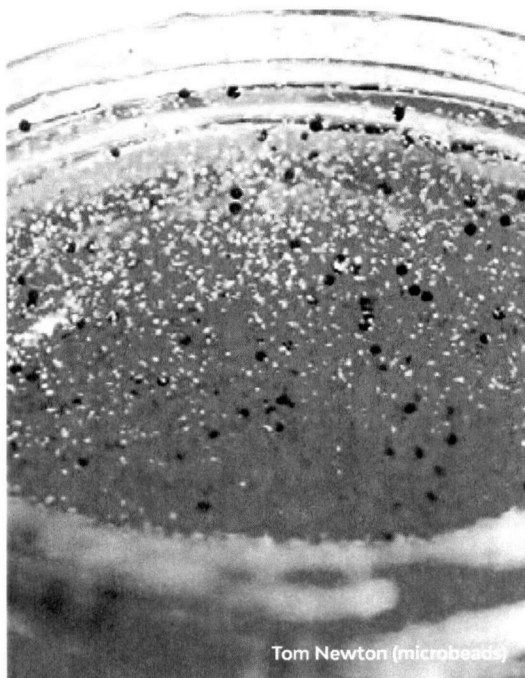
"Our recommendation is that annual reporting of pollution releases and transfers to the Great Lakes basin should be created so that there is annual reporting that provides us with an accurate base of data that we can all work with."

Jacqueline Wilson, Canadian Environmental Law Association, IJC public comment session at the Great Lakes Public Forum, Toronto, Ontario, October 5, 2016

Pollutants from Energy Production, Waste, Transportation and Storage

At every meeting and in a significant number of written comments, pollution threats from energy production, waste, transportation, and storage were identified as top public concerns. Many people expressed their belief that existing onsite nuclear waste storage and proposed nuclear waste storage facilities threaten the health and safety of Great Lakes waters, particularly the contaminated West Valley nuclear waste site 30 miles south of Buffalo and the proposed Deep Geological Repository near Lake Huron in Kincardine, Ontario. People also questioned whether adequate safeguards are in place for 38 operating nuclear power plants across the basin and for transporting nuclear waste through the watershed.

The safety of oil and natural gas pipelines was raised repeatedly at many of the meetings, particularly the Enbridge Line 5 pipeline that crosses the Straits of Mackinac in Michigan as well as others crossing the St. Marys and St. Clair rivers. People who raised the issue felt it would be impossible to contain spills from these pipes as well as from ships, trucks and other forms of transport, which could cause long-term, severe ecosystem degradation. The need for environmental and other risk-benefit analyses of proposed transport of petroleum-based fuels that cross wetlands and other sensitive habitats was also considered by some to be essential before new pipelines are approved. Hydraulic fracturing, petroleum coke (or petcoke) storage piles and thermal pollution were raised as additional reasons to review the safety of nuclear and other energy-producing activities.



Chemicals of Mutual Concern

Reflecting its standing as the seventh most-identified issue, a significant number of commenters recommended at meetings and in letters that radionuclides should be designated a chemical of mutual concern (CMC) under Annex 3 in the GLWQA. They want comprehensive research about and monitoring of human health impacts of radionuclides already present in the Great Lakes ecosystem, followed by action to prevent further introduction. Industry officials disputed this need in their emails and letters, citing rigorous existing regulations, standards and licensing in both countries that require strict compliance to ensure safe nuclear production.

Frustration was also expressed by some people that the Parties' process to identify CMCs has taken too long, that binational strategies to reduce, eliminate and prevent releases have not been developed for the eight chemicals identified thus far, and that transparency and education are needed on the threats and impacts caused by CMCs.

YOUR VOICE

"Please keep the Great Lakes Great! And FREE from chemical pollution. I can't believe I even have to write to ask this... but it is the world we live in."

Chrysta Bell, email, February 9, 2017

Objectives 5 and 7: Wetlands and Habitat, and Invasive Species

People said the importance of wetlands and their preservation cannot be understated because they provide vital ecological habitat and improve water quality by slowing the runoff of nutrients and filtering pollutants. For example, a nongovernmental organization in northwestern Ohio is creating small-scale wetlands adjacent to agricultural land as a way to slow the transport of nutrients into receiving waters and thus improve water quality. Another organization suggested that this could be duplicated in other tributaries throughout the Great Lakes region, which collectively contribute 48 percent of annual inflow into the lakes. Another suggestion was for governments to commit to adopting minimal thresholds to protect natural

habitats on a watershed basis. This might include a goal to restore and protect 40 percent of historic wetlands of a watershed, or committing to buffer strips with natural vegetation along both sides of streams within a watershed.



AV Zejnati (*Phragmites*)

The IJC heard from many people from all sectors of the region who universally believe aquatic invasive species have significantly impacted the Great Lakes ecosystem. Once aquatic invasive species are in the lakes they are virtually impossible to remove, so people also believe that governments must do everything possible to prevent new species from entering. Consistent and compatible ballast water requirements between the United States and Canada were listed as a necessary step to protect from future threats. Recommendations from nongovernmental organizations include passing more stringent ballast water and shipping regulations such as mandatory ballast water treatment equipment on all ships entering the Great Lakes from foreign ports, strict fines for non-compliance, and excluding foreign ships from the Great Lakes beyond the Port of Montreal.

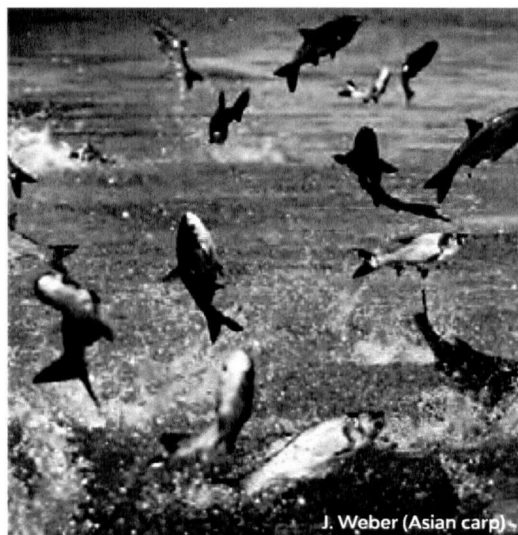
YOUR VOICE

"The Great Lakes fisheries are in danger from invasive species brought from ballast water and other threats such as the Asian carp advancing into the Great Lakes. We saw a similar problem with the alewives back in the 1960s. Let us learn from the past and prevent Asian carp from invading the lakes!"

Joseph P. Gallagher, Sault Ste. Marie,
Michigan, letter via email, April 11, 2017

Because Asian carp continue to pose an unacceptable risk to the lakes and native fisheries, many people throughout the region demanded that the Chicago Ship & Sanitary Canal be closed and/or a wide range of control measures used to prevent its entry. Given the devastating potential impact, several individuals and groups also called for collaboration between governments, indigenous nations, nongovernmental organizations, scientists and industry to create additional solutions that ensure Asian carp does not enter the lakes.

Terrestrial invasive species such as *Phragmites* were cited as additional threats, which can destroy habitat for native plants and devastate coastal ecosystems. People in the Lake Huron and Erie region, and in the Canadian portions of these lakes in particular, want increased research to identify sources and locations of infestations, improved mechanical and chemical controls, and expanded public awareness campaigns to share how invasive plants are spread and can be controlled.



J. Weber (Asian carp)

Objective 6: Nutrients

Participants in all of the public meetings and many who provided written or emailed comments felt that the harmful algal blooms caused by inputs of excessive nutrients into Lake Erie, as well as in Green Bay and the Lower Fox River in Lake Michigan and Saginaw Bay in Lake Huron, significantly impact lake health and create dangerous cyanobacteria toxins – a cause of recreation-based illnesses. Agricultural producer and fertilizer organizations commented that substantial increases in voluntary nutrient reduction and stewardship programs administered by national, state and local organizations and the agricultural community around Lake Erie deserve recognition for reductions achieved thus far. This includes the 4R program – using the right nutrient source at the right rate, at the right time, and in the right place – and its associated education, training and certification initiatives.

YOUR VOICE

"I have been a son of a property owner and property owner on Middle Bass island since 1963. The smells of the recent annual algae blooms in the lake brought me back to the late '60s and early '70s prior to Governor Rhodes hammering Proctor and Gamble to eliminate phosphate from Lake Erie. There are reams of data on phosphate in the lake but much less information on where it comes from."

Matt Richardson, Middle Bass Island, Ohio, via email April 7, 2017

YOUR VOICE

"Specifically in agriculture, nongovernmental voluntary efforts for nutrient stewardship to address water quality have increased significantly in the last five years, and they should be recognized for their contribution to addressing Lake Erie water quality. Efforts by industry in partnership with crop and conservation organizations are growing and leading to successful implementation of practices on the farm... Mandatory regulations risk undermining innovation, reduce the incentive to go beyond minimum requirements and are time consuming and difficult to update and modify."

Agribusiness Council of Indiana, Fertilizer Canada, International Plant Nutrition Institute, Michigan Agribusiness Association, Ohio Agribusiness Association, The Fertilizer Institute, letter via email, April 13, 2017

Other organizations and individuals, particularly from the Lake Erie basin, said that intense harmful algal blooms every summer prove that voluntary actions alone will not reach the goal of 40 percent reduction in phosphorus loadings entering the western and central basins of the lake as set by the Parties. Many called for the western basin of Lake Erie to be listed as impaired under the US Clean Water Act's criteria for recreational uses to ensure that mandatory regulations are implemented, including domestic action plans in the

United States with enforceable programs and timelines. Several people at the Toledo meeting felt that nutrient loadings will diminish considerably if widespread use of animal waste as fertilizer on fields by concentrated animal feeding operations, or CAFOs, is regulated along with crop farmers' use of granule or liquid fertilizer. Also mentioned was the need for mandatory education, training and support for best practices for farmers to reduce nutrient loadings.

In addition, some people in Wisconsin and Michigan asked for increased support for monitoring, outreach and regulations enforcement on phosphorus loadings in Green Bay and the Lower Fox River and in Saginaw Bay, and in other areas where

dissolved phosphorus loadings contribute to the growth of the green algae *Cladophora*. Other suggestions to control nutrient sources included creating a drain code for all Great Lakes basin land, developing regional water plans that include collaboration between urban and rural communities, and using a results-based regulatory and enforcement approach to address all point and nonpoint sources of phosphorus and nitrogen. Another recommendation made by a research and policy organization was that monitoring needs to target multiple watershed scales and the many loading sources in order to accurately detect trends in nutrient concentrations.

OTHER TOPICS OF CONCERN

Participants and presenters at every public meeting highlighted success stories in restoring **Areas of Concern**, from eliminating sources of toxic pollution to rebuilding habitat and restoring recreational uses. At the same time, municipal leaders and others voiced concerns about potential reductions in federal financial support in key areas such as infrastructure improvements and large-scale remediation projects that will impact momentum and continued progress, particularly in areas of recovery and post-delisted Areas of Concern. Equally important is monitoring to ensure that impairments are prevented from returning or that new development is allowed that may endanger restored areas, such as at the Menominee River shared by Michigan and Wisconsin. Participants in the Sault Ste. Marie and

Buffalo meetings expressed frustration with the dissolution of the Lake Superior **Lakewide Action and Management Plan's** citizen forums and the absence of outreach and education subcommittees.

Many people throughout the region recognize that **climate change** is already affecting the Great Lakes ecosystem, from increases in water temperatures and extreme weather events to alteration of biological communities and habitats. Several suggested that the region needs to appreciate the priceless resources the lakes provide and take collective action now to protect them – from the direct effects of climate change in the region to potential large-scale water diversions as a result of climate change impacts in other regions of the continent.



First Nations, Tribes and Métis

representatives stated that the time has long past for their active inclusion in Great Lakes management. During the IJC's public comment session at the Parties' Great Lakes Public Forum in Toronto, in listening sessions and public meetings in Sault Ste. Marie and Sarnia, and at a meeting with the Métis Nation of Ontario in Toronto, they reinforced the indigenous philosophy of water as a sacred, living entity rather than an asset to be used, the intrinsic and economic price they have and are paying for others' perspectives and actions, and the need to include their people in effective actions to restore and protect the lakes. Some contributors also expressed appreciation to the IJC for including representatives of indigenous peoples on its Great Lakes advisory boards.

YOUR VOICE

"It is time for the IJC to recognize the jurisdiction inherent and treaty rights of First Nations in all governance matters affecting the homeland of many First Nations across the Great Lakes...In making this request, we acknowledge the steps that the IJC has already taken, in particular the appointment of Dr. Henry Lickers ... to the Science Advisory Board and Mr. Dean Jacobs to the Water Quality Board. We acknowledge these steps. They are in the right direction."

Grand Chief Abram Benedict, Chiefs of Ontario,
IJC public comment session at the Great Lakes
Public Forum, October 5, 2016

People throughout the Great Lakes basin also desire greater involvement in the wide range of issues that impact the lakes, human health and their quality of life, and called for governments to commit to **meaningful outreach and engagement** among and

within a wide range of communities. Equally important is continued funding of research, remediation and protection actions to ensure that progress continues to restore and protect the Great Lakes.

PROGRESS REPORT OF THE PARTIES (PROP)

Although many of the topics raised by the public in their comments are related to the PROP, limited input was received specifically about the report during the IJC's public comment sessions, at the Great Lakes Public Forum or in subsequent correspondence. In the small number of comments received on the report, the most common response was the need to translate data into wording the public can understand, and explaining the many acronyms that are not familiar to the broader community. Second, commenters felt that publicity about the report and the Forum was virtually nonexistent to the general public, which reflects poorly on the Parties' commitment to meaningful communications and outreach. They suggest the Forum was a lost opportunity for the Parties to share their progress toward meeting the GLWQA's objectives, and the importance of the evolving science and monitoring programs that assess the state of the lakes. Given the wealth of information provided in the PROP on Agreement progress and the value of science and monitoring programs, people said the report provides ample argument that financial and program support is essential to continue progress in these programs.

Specific public reactions to the PROP included:

- One nongovernmental Great Lakes organization applauded the Parties' efforts to produce Progress Reports of the Parties as well as State of the Great Lakes reports preceding the IJC's triennial reviews. It suggests that the intent of each report and how the public should best provide comment is important to clarify.
- Several people and groups in the Lake Erie basin feel that the lake's domestic action plans lack detail. The plans must include programs, policies and protections that successfully meet nutrient reduction targets. Without these, the plans will fail to achieve the 40 percent reduction goal, just as voluntary attempts to control nutrient pollution have failed elsewhere.
- The PROP states that expanding edge-of-field monitoring is underway in the United States, but results are not provided. Edge-of-field monitoring is used to assess the quantity and quality of agricultural runoff and evaluate conservation practices that aim to reduce sediment and nutrient loss.

It also can help to identify agricultural sources of excess nutrients that threaten the health of the Great Lakes. These results will be valuable when combined with existing watershed-level monitoring efforts and data.

- Social science and human health indicators should be created and incorporated into future progress reports to provide ongoing data on location-specific access to clean, affordable drinking water and safe beaches, disease outbreaks due to cyanobacteria exposure, consistent and well publicized fish consumption advisories, and the progress

and costs of infrastructure improvements to obtain zero discharge of raw sewage into the lakes. These data will illustrate which communities are succeeding and which are not in providing drinkable, swimmable and fishable water to their residents.

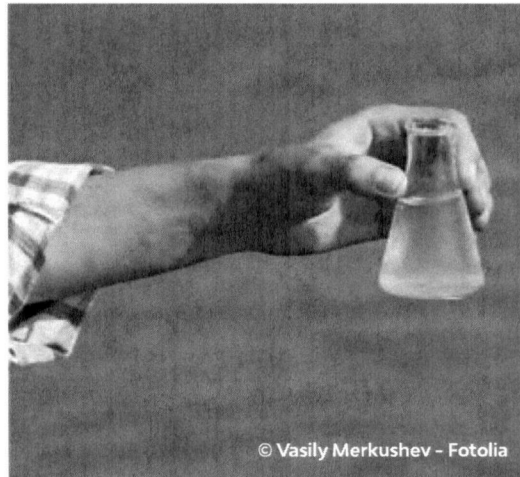
- The 2016 Progress Report of the Parties generalizes information across entire lake basins, which does not provide the level of details the public needs.
- Annex committees should be expanded to include experts in social science, public health and economics.

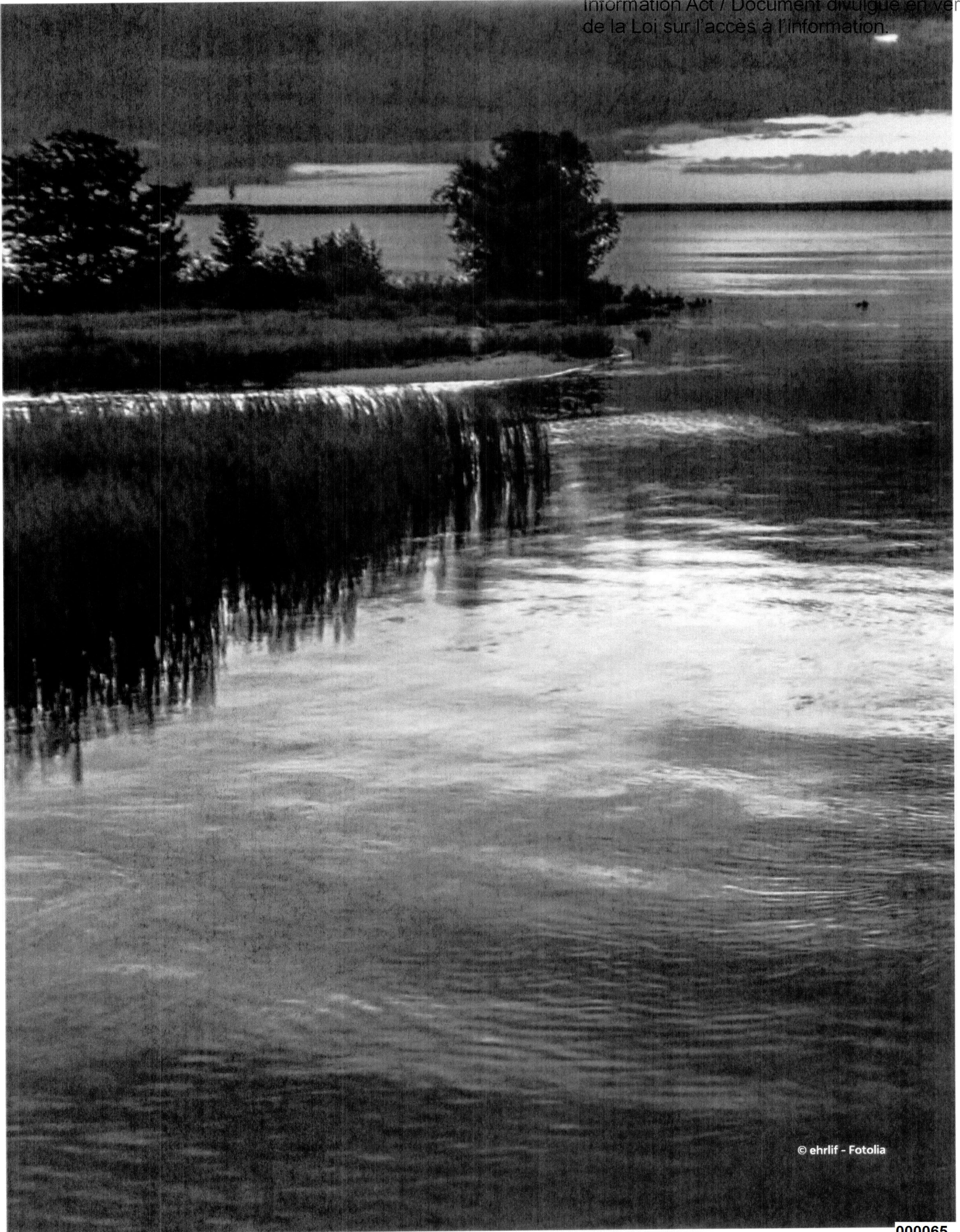


R. Bejankiwar

CONCLUSION

As the IJC talked with and heard from people throughout the Great Lakes region, the level of interest in, commitment to and sense of personal responsibility for the health of the lakes – now and for future generations – was abundantly clear. They want to be informed about efforts to restore and protect the lakes, and they want opportunities to participate in that work. Whether they addressed harmful algal blooms, toxic contamination or limits to recreational use, residents want the Parties to take aggressive and sustained actions to meet commitments made in the GLWQA. This includes stronger enforcement of existing rules and programs addressing nutrient and toxic pollution, greater investment in infrastructure to prevent combined sewer overflows, continued progress to restore Areas of Concern, and a focus on the GLWQA's principles of accountability, and preventing future inputs of pollution and other threats to the health of the Great Lakes and to people who live in the watershed.





4.

CONSIDERATION OF STATE OF THE GREAT LAKES REPORT

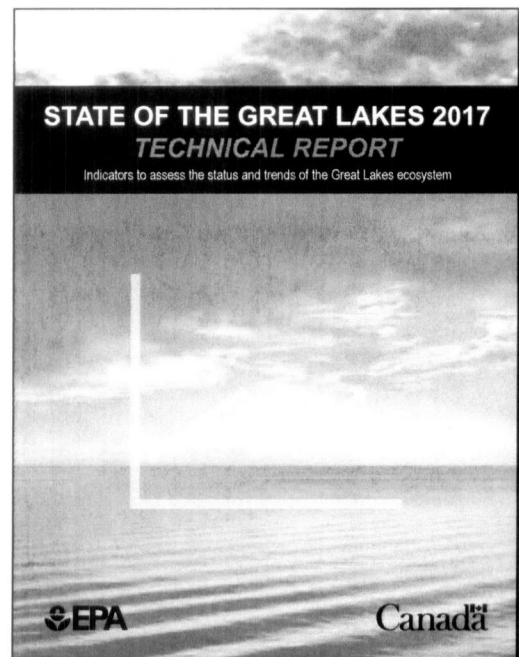
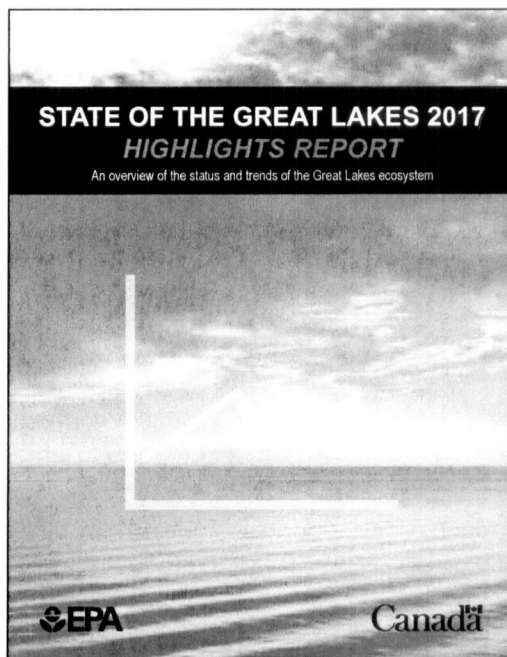
OVERVIEW

The GLWQA requires the IJC's triennial assessment of progress to include "consideration of the most recent State of the Lakes Report." This report considers State of the Great Lakes (SOGL) 2017 in two main respects. First, this chapter provides a short review of indicator information the Parties have used in preparing their SOGL reports and suggests potential future enhancements. Second, Chapter five considers indicator status and trend information as part of the IJC's assessment of the extent to which programs and other measures are achieving Agreement objectives.

The GLWQA requires the Parties to establish and maintain comprehensive, science-based ecosystem indicators to assess the state of the Great Lakes, to anticipate emerging threats and to measure progress in relation to achievement of the Agreement's general and specific objectives. These indicators shall be periodically reviewed and updated as necessary. The GLWQA also dictates that the Parties shall issue a SOGL report to the IJC and the public every three years, which describes basinwide environmental trends and lake-specific conditions using these ecosystem indicators.

The first SOGL report developed and issued under the 2012 GLWQA was released as a highlights (summary) report in June 2017. The full technical report was released in September 2017. As the technical report was released shortly before the finalization of this report, the IJC had limited time to extensively consider its contents in this assessment. In the future, the Parties should coordinate the release of the SOGL highlights and technical reports with the Progress Report of the Parties (PROP) to yield a more informative and complete package for the public, and enable the IJC to consider all government reporting in its assessment of progress and provision of advice to governments.

As the SOGL Highlights report was released after the IJC's collection of public input on progress under the GLWQA, no public comments were received on the SOGL report. Public comments on indicator information reported by the parties at the Great Lakes Public Forum in October 2016 are addressed in chapter three, Summary of Public Input and chapter five, Assessment of Progress Toward General Objectives.



BACKGROUND

It is important to effectively communicate the status and trends of the Great Lakes to the public in terms that can be readily understood. This will improve public awareness of the inherent value of the Great Lakes and the benefit of taking actions to protect and restore these waters. Assessing and reporting on the condition of a large-scale regional ecosystem such as the Great Lakes basin and communicating the findings to the public can be demanding.

Indicators are needed to describe the condition of the environment in the same manner as indicators are used to describe human health (for example, blood pressure) and economic conditions (for example, Dow Jones Index). Ecological information adds another level of complexity to communication with the public because, by its very nature, ecology reflects the interaction of a multitude of organisms with each other and their environment. The [Technical appendix](#) to this report describes some of the challenges of communicating scientific information and offers examples used by other environmental assessment programs to overcome them.

Indicators

The Parties developed State of the Great Lakes reporting to assess the status of the Great Lakes. On page two of the SOGL report, the Parties describe how they used indicators and sub-indicators in their assessment, as follows: "The governments of Canada and the United States, together with their many partners in protecting the Great Lakes, have agreed on a set of nine indicators of ecosystem health. These indicators are in turn supported by 44 sub-indicators, measuring such things as concentrations of contaminants in water and fish tissue, changes in the quality and abundance of wetland habitat, and the introduction and spread of invasive species."

https://binational.net/wp-content/uploads/2017/06/SOGL_17-EN.pdf

The SOGL reports set out the status of each sub-indicator and summary indicator as poor, fair, good or undetermined. Trends in sub-indicator and indicator levels are described as deteriorating, unchanging, improving or undetermined. In this TAP report, these government assessments of indicator and sub-indicator status and trends are shown relative to each general objective in Chapter five.

It is also a challenge to summarize succinctly the status and trends of the several metrics or sub-indicators that are included in an indicator. The SOGL 2017 report builds on the history of State of the Lakes Ecosystem Conference (SOLEC) reporting, which uses indicators that governments began in 1994. The IJC has offered considerable advice to governments on their use of indicators and associated reporting. In its 16th Biennial Report on Great Lakes Water Quality issued in 2013, the IJC recommended that

the Parties' SOGL reporting use a smaller set of indicators connected to the GLWQA objectives, and that the indicators have plain language descriptions and be presented in a report card format readily understood by the public. In 2014, the IJC followed with recommendations to the Parties on specific ecosystem sub-indicators for SOGL reporting. Also in 2014, the IJC forwarded advice to the governments on Great Lakes indicators related to human health.

CONSIDERING STATE OF THE LAKES 2017



The SOGL Highlights report issued in June 2017 is a clear and concise report that sets out indicator status and trend information for each GLWQA general objective in an engaging way. The SOGL Technical report provided detailed information on each sub-indicator. The Parties improved the SOGL 2017 reporting from past SOLEC reporting

by adopting the IJC recommendation to reorganize the report into nine indicators (with various metrics or sub-indicators) that are linked to the GLWQA's general objectives. The Parties also graded the status of indicators and sub-indicators related to each objective, and included new sub-indicators.

In future triennial cycles, the SOGL Highlights report could include links to more information (for example, the SOGL Technical report, the PROP, and other websites), videos and interactive maps. Interpreting the key scientific findings via stories that connect indicators to each other and to observable phenomena would help people understand that behind every indicator are many other factors to consider. For example, telling stories about how forest and land cover, rainfall, water temperature, dreissenid mussels, nutrients in lakes, and harmful algal blooms (HABs) are all inter-related would help the public understand the importance of these specific sub-indicators.

The SOGL 2011 Technical Report effectively used storytelling. Going further and connecting these indicator stories to management actions discussed in the PROP would provide more context to understand status and trends. Interactive maps, such as applying the approach used by NOAA's Interactive Radar Map Tool to connect weather patterns to beach conditions, would enable interested readers to explore specific areas within the basin in more detail.

Current averaging of many indicator results across the basin or even within individual lakes obscures the high and low impacts in specific areas. Links to lake or basin reports, maps or videos could provide clear messages about areas that are especially pristine or degraded. The use of video, which has become more common in public messaging and used by other large-scale assessments, would improve the accessibility and delivery of information. For instance, the Chesapeake Bay Program tracks progress using indicators (for example, blue crab abundance) that present layers of progressively more detailed information, including videos.

The next two sections describe two ways in which SOGL reporting could be improved.

1. SOGL Technical Report - Indicator gaps

The IJC has identified improvements and recommended refinements to Great Lakes indicators. The IJC believes the sub-indicators that the Parties used in the SOGL 2017 report do an outstanding job reflecting the status and trends associated with the nine general objectives of the

GLWQA. However, a report produced by the Research Coordinating Committee of the IJC's Science Advisory Board in 2016 showed that further improvements could be made to several ecosystem and human health sub-indicators.

2. Indicator Reporting

The Parties should collate data on indicators in a centralized and publicly accessible location. This will encourage standardization of data collection and assessment methods, which is needed to increase consistency in assessing long-term trends and detecting changes in lake health status. There is reasonable data coverage for a status assessment for the majority of sub-indicators in the SOGL report. Insufficient data are available for detecting trends for the coastal wetlands extent and composition sub-indicator and the harmful algal bloom (HAB) sub-indicator.

Several sub-indicators that are critically important to assess GLWQA progress are not included in the suite of indicators used in SOGL 2017 reporting. These include: the biological hazards and chemical integrity of source water (as opposed to treated drinking water); illness risk at beaches and the source of risks at beaches; tributary loadings and nearshore concentrations of total phosphorus and dissolved reactive phosphorus; recruitment and abundance of nearshore predators (bass and northern pike); and invasion rates and impacts of invasive plankton, round goby, Eurasian ruffe, and Asian carp. The Parties should include these additional sub-indicators in the next SOGL Technical report.

It is critically important for the Canadian and United States governments to fund and maintain a comprehensive and well-designed binational water quality monitoring program within the Great Lakes. Data from such a monitoring program are essential for forecasting change, preventing and mitigating impacts, and restoring and preserving the Great Lakes. Data are also needed to understand the linkages between storm events, agricultural and urban runoff,

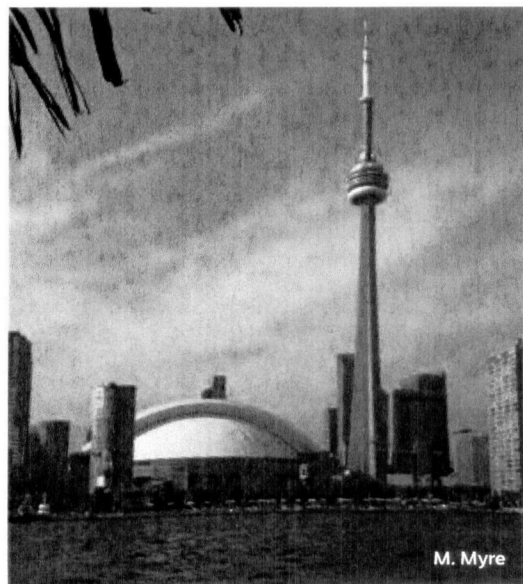
combined sewer overflows, and harmful algal blooms in order to develop effective prevention and mitigation strategies.

Information could also be used to identify emerging water quality issues and to show changes in trends on key ecological and human health parameters. These data would also help governments and the IJC to respond to questions about whether the lakes are getting cleaner.

IJC GREAT LAKES VITAL SIGNS

Considering the need to communicate key aspects of Great Lakes status and trends more clearly and concisely, the Science Priority Committee of the IJC's Science Advisory Board (SAB-SPC) developed another process to use scientific data that tells meaningful and compelling stories to the public about the Great Lakes ecosystem.

In 2016, the SAB-SPC issued a report on indicators that followed a rigorous process to select eight ecosystem measures deemed most communicable to the public. The SAB-SPC recommended that this process be repeated on a regular basis, perhaps every six to nine years as lake conditions, public interest and data availability change over time. The SAB-SPC also recommended that the exercise be expanded to include human health measures.



Based on the SAB-SPC report, the IJC identified Great Lakes Vital Signs, a refined set of eight measures that can be used to present rich yet concise information on the status and trends in Great Lakes health to the public. The IJC generally concurred with six of the eight measures recommended by SAB-SPC, but felt harmful algal blooms are better as a measure than nuisance algae because of public health impacts and data availability. The IJC also selected dissolved reactive phosphorus in addition to total phosphorus, because the dissolved form is more readily available for algal uptake and more influential

in promoting harmful algal blooms. The eight measures that the IJC would like to use for future vital signs reporting include:

- persistent bioaccumulative toxics in whole fish
- mercury and atrazine concentrations in water
- lake trout / lake whitefish abundance (walleye for Lake Erie)
- HABs in western Lake Erie, Saginaw Bay, and Green Bay using remote sensing images and the western Lake Erie Severity Index (presented at the Great Lakes Public Forum)
- total phosphorus and dissolved reactive phosphorus tributary loadings for the three sub-basins mentioned above and concentrations in the offshore in all the lakes
- sea lamprey abundance
- maximum ice cover
- long-term water level variability.

These vital signs are well suited for public communication. Reporting to the public on whether the lakes are getting better or worse would be enhanced by including data on these eight vital signs in the next TAP report. However, not all of the vital signs are included as sub-indicators in SOGL reporting. These vital signs should be included by the Parties in the next SOGL.

CONCLUSION

Large-scale reporting on the Great Lakes is needed along with non-technical communication to help the public understand the condition of the lakes and motivate

or support actions to protect and restore them. The SOGL 2017 Highlights report provides clear and concise information on the status and trends of Great Lakes indicators relative to the general objectives of the GLWQA. The Parties have improved their reporting in SOGL 2017 by linking indicators to objectives and using a report card format for each objective. Looking ahead to future SOGL triennial reports, potential enhancements include coordinated release with the PROP and cross-references or links between the two reports, along with links to interactive maps and videos. Providing more storytelling in the Highlights report would help the public understand how the system functions and the interrelationships between sub-indicators. Another improvement to SOGL reporting could be achieved by adding the sub-indicators suggested by the IJC and ensuring the IJC vital signs are included as sub-indicators in SOGL reporting. Comprehensive binational monitoring needs to be strengthened to further improve indicator data and reporting.

RECOMMENDATION

To further improve reporting, the IJC recommends that:

- The Parties strengthen support for a comprehensive binational Great Lakes monitoring program to provide the essential information and understanding needed to quantify and interpret indicators, forecast change, prevent or mitigate impacts and restore and preserve the Great Lakes ecosystem.



F. Wyma



5. ASSESSMENT OF PROGRESS TOWARD GENERAL OBJECTIVES

The GLWQA requires the IJC's Triennial Assessment of Progress (TAP) report to include "an assessment of the extent to which programs and other measures are achieving the general and specific objectives of the Agreement." This chapter assesses selected programs and measures in the context of their contribution to achieving the GLWQA's general objectives and considering the State of the Great Lakes (SOGL) report. Additional assessment of and background detail regarding programs and measures related to the GLWQA's general objectives are presented in the accompanying Technical appendix report.

1. DRINKING WATER

General Objective 1:

The Waters of the Great Lakes should be a source of safe, high-quality drinking water.

SOGL Indicator

Drinking Water for the overall Great Lakes Basin: status good, trend unchanging

Sub-indicator across the basin:

- *Treated Drinking Water*: status good, trend unchanging.



Jean Clicclat

Summary of the status and trend of the State of the Great Lakes Drinking Water sub-indicator for the Great Lakes (Source: SOGL, 2017)

Sub-Indicator	Lake Superior	Lake Michigan	Lake Huron	Lake Erie	Lake Ontario
Treated Drinking Water	No lake was assessed separately Great Lakes Basin assessment is Good and Unchanging				
Status:	GOOD	FAIR	POOR	UNDETERMINED	

Overview

Treatment technologies and care on the part of drinking water system operators help to deliver clean, safe water an overwhelming majority of the time. However, the rare occasions when drinking water is compromised – such as the microcystin contaminations that happened in Toledo and Pelee Island in 2014 – can have tragic consequences for the health and livelihood of those impacted. Preventing further compromises of Great Lakes drinking water systems requires continued vigilance, foresight and investment and needs to be of utmost importance in GLWQA implementation. Furthermore, access to

clean water is of particular importance to indigenous peoples, not just for the protection of human health, but also for the important role water plays in their cultural practices and teachings.

The absence of a SOGL indicator for source water quality is a significant gap in ensuring the safety of drinking water and in the assessment of progress for this objective. Protecting source water for drinking water supplies, rather than simply treating water *after* it is withdrawn, is consistent with the prevention approach in the GLWQA and an important part of source-to-tap

protection. Additionally, the Progress Report of the Parties (PROP) does not have a human health-oriented summary of the quality of the waters of the Great Lakes or a summary of the annex activities to address the GLWQA's human health objectives. The lack of reporting on this and the other two human health objectives make it challenging to assess progress towards their attainment.

Background

The Great Lakes and their connecting river systems are a source of drinking water to more than 40 million Canadians and Americans. However, these waters are susceptible to contamination from a variety of sources. As a result, the protection of these source waters is an important first step in the provision of safe drinking water. Protecting drinking water requires a comprehensive, “multi-barrier” approach, including source water protection, appropriate treatment, and infrastructure maintenance and monitoring throughout the delivery and distribution system.

Residents of the Great Lakes basin have experienced a number of serious drinking water contamination incidents, including: the *E. coli* O157:H7 contamination of a source water supply in Walkerton, Ontario (2000); the 2014 “do not drink” advisories for Toledo, Ohio and Pelee Island, Ontario in response to unsafe levels of microcystin in the treated water; and the 2015 crisis in Flint, Michigan, in which elevated levels of lead leached from distribution pipes as a result of failure to apply adequate anti-corrosion control.

Although only the water supplies that impacted Toledo and Pelee Island were drawn from the waters of the Great Lakes, these incidents serve as a reminder of the vulnerability and importance of safe drinking water. In addition, they may offer lessons that can lead to future improvements in the protection and delivery of safe drinking water. For example, the 2000 Walkerton incident resulted in the establishment of the *Ontario Safe Drinking Water Act* and the *Ontario Clean Water Act*, which together form the regulatory framework for a comprehensive management approach to drinking water.

While it is a positive step that lessons have been learned through these tragic events, a proactive approach that embodies the prevention principle called for by the GLWQA is required.

Prevention

The GLWQA defines prevention as anticipating and preventing pollution and other threats to the quality of the waters of the Great Lakes to reduce overall risks to the environment and human health.

*“Treatment without prevention
is simply unsustainable.”*

– Bill Gates

Assessment

The Parties’ 2017 SOGL Highlights report illustrates that the Great Lakes are a high quality source of drinking water as currently reported separately for Canada and the United States.

According to the 2017 SOGL report, 60 percent of the population in Ontario receives its drinking water from the Great Lakes. Treated drinking water samples met the Ontario Drinking Water Quality Standards 99.8 to 99.9 percent of the time from 2007 through 2014. This represents samples taken from municipal systems and does not include private or First Nations systems. Water for these municipal systems is taken from the Great Lakes, inland lakes, rivers and groundwater. The samples included microbial, chemical and radiological parameters. Treated drinking water samples met radiological standards 100 percent of the time, chemical standards at least 99.67 percent of the time and microbial standards at least 99.85 percent of the time.

In the United States, SOGL reporting shows that from 2012-2014, 95 to 97 percent of the population living in the Great Lakes basin (approximately 27 million people) were served by water treatment systems meeting all health-

based water quality standards. During this same period, 6 percent of the water treatment systems incurred health-based system violations. It is not clear from the data reported whether this also includes Tribal communities.

Under Annex 1 (Areas of Concern or AOCs), progress has been made to remove restrictions on drinking water consumption, or taste and odour problems. Of the 43 AOCs designated by the Parties, ten have had a beneficial use impairment (BUI) associated with restrictions on drinking water consumption. To date, the Parties have removed this BUI at seven AOCs, with two of the remaining AOCs expected to remove the BUI within the next two to three years.

Beneficial use impairments in Areas of Concern

AOCs are geographic areas designated by the Parties where significant impairment of beneficial uses has occurred because of human activities at the local level. BUIs are changes in the chemical, physical or biological integrity of the Great Lakes system sufficient to cause restrictions on uses.

Overall, people living in the Great Lakes basin can safely drink municipally treated drinking water, unless an advisory is in place.

However, not all populations in the basin get their drinking water from municipal systems and even for the samples reported, there is not 100 percent compliance with drinking water standards. **When it comes to safe drinking water, nothing less than 100 percent is acceptable.**

Source water

The SOGL Technical report includes data on the quality of source water samples taken in Ontario only, the status of which is "good." This is not reported in the SOGL Highlights report, which characterizes the quality of drinking water only after treatment. However, the GLWQA general objective identifies source water – that is, water quality prior to treatment. Greater focus on source water quality in SOGL reporting would provide a more direct

connection between indicator data and the first objective of the Agreement that the lakes should be a source of safe, high-quality drinking water. The lack of reporting on source water quality creates a gap in assessing progress toward meeting objective 1 under the GLWQA.

In 2014, based on a Health Professionals Advisory Board report, the IJC recommended the Parties adopt a set of human health indicators to assess progress under the GLWQA. The two indicators for source water, chemical integrity and biological hazard index, provide a cross-section of compounds potentially hazardous to human health for monitoring at source water intakes of drinking water treatment plants. The report underscored the importance of having the Great Lakes as a source of clean drinking water.



Measuring source water quality

The quality of the waters of the Great Lakes is measured in many ways at many locations. The measurement of source water for drinking is considered to consist of measuring parameters relevant to drinking water where drinking water is being extracted, before it is treated. For example, the Ontario source water data reports on the percentage of drinking water systems where source water, monitored before treatment at over one hundred drinking water systems in the province, met Ontario Drinking Water Quality Standards.

A key component in the delivery of safe drinking water is the development and implementation of source water protection plans (SWPPs). The requirement for the development and implementation of SWPPs varies between Ontario, where it is mandated, and the US states, where it is voluntary. The Ontario Clean Water Act requires the development of watershed-based SWPPs as a first step in a multi-barrier approach to protecting existing and future sources of drinking water.

The US Safe Drinking Water Act includes provisions intended to protect the nation's drinking water at all sources to reduce water treatment costs and risks to public health. The act required that, by 2003, each state develop a Source Water Assessment Program to assess the susceptibility of public drinking water supplies to contamination. The act also requires states to develop a source water protection program but relies on voluntary state and local efforts. The assessments are intended to provide information to local stakeholders to prioritize actions in protecting the drinking water supply and encourage partnerships among local, state and regional agencies to manage and prevent contamination. Mandating the development of SWPPs, like the approach in Ontario, would offer an extra measure of protection.

Communities and drinking water

Both Parties have collaborated with provincial, state, municipal, First Nations and Tribal governments in supporting essential infrastructure for drinking water treatment systems. However, the federal share of funding has changed over time. After signing the 1972 GLWQA, the Parties shouldered the preponderance of costs for wastewater and drinking water treatment. Over the ensuing decades, the US federal contribution has waned, putting significant upward pressure on US customer billing rates and fostering a steep increase in household service shutoffs due to payment delinquency.

At the IJC public meeting in Detroit, the Commission heard from many people concerned about their loss of access to safe drinking water due to cost. Although some may question whether these concerns fall within the scope of the GLWQA, the Commission believes that it is important that these voices are heard by the governments. The comments received on this topic, and presented in full in the Summary of Public Comment appendix, should be forwarded to appropriate agencies and decision makers. The Commission encourages the governments to take steps to assure that clean drinking water is available to all without regard to ability to pay. More than 300 municipalities take water from the Great Lakes; if it is prohibitively expensive to afford treated drinking water, the result is contrary to the intent of general objective 1 of the GLWQA.

YOUR VOICE

"We are right here in the middle of the city, and we don't have reliable water, and it's also priced too high. We have some of the highest priced water, and we are surrounded by water. Places that don't have water near them pay less than we do."

Stephen Boyle, IJC Public Meeting on the Great Lakes, Detroit, Michigan, March 21, 2017

Tribes and First Nations

Tribes

Tribal public water systems in the United States have more health-based violations of the US Safe Drinking Water Act (SDWA) than the US national average. They also have more SDWA violations overall, including those related to monitoring and reporting. In 2010, over five percent of tribal homes in the United States did not have access to safe drinking water. Many tribes are decades behind non-tribal communities in developing systems for compliance with environmental programs because of their initial exclusion from major environmental statutes established in the 1970s, such as the SDWA. Along with other major environmental laws originally established at that time, the SDWA did not include provisions for implementation on tribal lands for another 20 years.

First Nations

Drinking water advisories are used to alert communities when drinking water is not safe for consumptive use. In Canada, Human Rights Watch reports that these advisories, including boil water advisories, occur disproportionately in First Nations communities across the country as compared to the general population. As of July 2017, Ontario had 92 drinking water advisories on First Nations reserves. Several of these are on reserves located in the Great Lakes basin, beginning as early as 2003. Several factors contribute to the water crisis experienced by First Nations, including lack of binding regulations on water quality for First Nations

reserves; continuous under-funding for water system costs (capital, operations and maintenance); worsening conditions of source water; and lack of capacity and support for water operators.

In Canada, provincial and territorial regulations for safe drinking water do not extend to First Nations reserves. Only

the federal government has the authority to pass binding regulations applicable to First Nations reserves. There are currently no drinking water regulations on reserves, though the federal government does provide protocols and standards for design, construction, operation, maintenance and monitoring of drinking water systems in First Nations communities.

Drinking Water Advisories

Drinking water advisories in Canada include boil water, do not drink, and do not consume advisories. Boil water advisories are issued when drinking water has been, or is suspected to be, compromised by disease-causing organisms. "Do not consume" and "do not use" advisories are used when a chemical contaminant is present, or suspected to be present, in a drinking water supply. Similar categories are used in the different US states, though instead of advisories they could be labelled as drinking water "notices," "alerts," or "orders." The vast majority of advisories issued in Canada are boil water advisories. The causes of boil water advisories are most often due to a failure in the drinking water treatment process, equipment or distribution system. A similar breakdown of advisories and their causes could not be found for the United States.

This material is taken from an ECCC report, "Canadian Environmental Sustainability Indicators Drinking Water Advisories in Canada." https://www.ec.gc.ca/indicateurs-indicators/2C75C17A-BD2D-499A-9C8D-4B38E275727B/DrinkingWaterAdvisories_EN.pdf

And the US Center for Disease Control's Drinking Water Advisory Communication Toolbox. <https://www.cdc.gov/healthywater/pdf/emergency/drinking-water-advisory-communication-toolbox.pdf>

YOUR VOICE

"My First Nation is 20 miles downstream from Michigan's upper peninsula mines. We receive all of their effluent so we've been on boiling water restrictions for years...We are the guardians for the lakes and yet we pay the price for others' actions, including poor management of the lands."

Chief Joe Buckell, Michipicoten First Nation, Public Meeting on the Great Lakes, Sault Ste. Marie, Ontario, March 2, 2017

Improvements in indicator reporting

The drinking water indicator presented in the Parties' SOGL Highlights report uses municipally treated drinking water quality only. While it is useful for the public to know it is safe to drink treated water, it does not properly assess progress towards the GLWQA's objective 1 that the waters of the Great Lakes "should be a source of safe, high-quality drinking water."

The Ontario Drinking Water Surveillance Program collects untreated (source water) and treated drinking water samples from drinking water facilities and analyzes for a suite of organic and inorganic contaminants, both regulated and non-regulated. There is currently no national US database for source water used as a public drinking water supply. A federal repository for source water data could be established (or current repositories augmented, such as the electronic Storage

and Retrieval/Water Quality Exchange data systems), to enhance indicator reporting under SOGL. Additionally, collecting such data over long periods would allow for assessment of trends and changes in source water quality, and would inform source water assessments and protection planning.



Gaps in Annex Implementation

The GLWQA highlights the important connection between the quality of Great Lakes waters with human health, particularly the need to restore nearshore waters since they are a major source of drinking water. However, a human health-oriented summary of the quality of Great Lakes waters doesn't exist in the PROP, nor does it report on activities to address human health issues or the drinking water general objective.

To increase the prominence in the GLWQA of the connection of human health to the quality of Great Lakes waters, a committee could be organized around human use of Great Lakes waters, including source waters used for drinking water. The committee could report on human health activities under the GLWQA, including domestic and binational actions specifically aimed at making progress toward achieving objective 1. The committee could also enhance the public's understanding of the Parties' efforts to address human health as affected by the waters of the Great Lakes, and examine emerging water quality issues that could affect human health. Such a committee could become a link among the various annexes that affect the source waters used for drinking (e.g. climate change, chemicals of mutual concern), increasing the importance of, and giving greater consideration to, drinking water impacts. Finally, it could provide an additional mechanism to engage the First Nations, Tribal and Métis communities, populations which may often rely on untreated sources of water for drinking, and incorporate traditional knowledge in protecting the waters of the Great Lakes.

Conclusion

Federal, state, provincial and local governments have provided safe drinking water almost all of the time nearly everywhere in the basin. However, unsafe drinking water incidents have occurred in major cities and some First Nations and Tribes have had longstanding boil water advisories. The Commission considers 100 percent clean water as the only acceptable situation.

Protecting source water for drinking water supplies – where it is not already mandated – would help to reduce costs of treating water after it is withdrawn and benefit those drinking water supplies drawn directly from the lakes. This is also consistent with the prevention approach in the GLWQA. SOGL reporting should cover source waters in both countries, and increased binational collaboration on all human health issues would help to improve reporting and progress.

Recommendations

To improve progress toward the objective that the waters of the Great Lakes should be a source of safe, high-quality drinking water, the IJC recommends that:

- The Parties monitor and report on source water quality for drinking water, and the United States match the Ontario requirement for source water protection plans to protect drinking water supplies.
- The Parties address infrastructure needs to eliminate all longstanding boil water advisories and persistent drinking water violations for communities everywhere in the Great Lakes basin.

2. SWIMMING AND RECREATIONAL USE

GENERAL OBJECTIVE 2

The Waters of the Great Lakes should allow for swimming and other recreational use, unrestricted by environmental quality concerns.

SOGL Indicator

Beaches for the overall Great Lakes Basin:
status fair to good, trend unchanging

Sub-indicator across the basin:

- *Beach Advisories*: status fair to good, trend unchanging.



Summary of the status and trend of the State of the Great Lakes Swimming and Recreational use sub-indicator and each Great Lake (Source: SOGL, 2017)

Sub-Indicator	Lake Superior	Lake Michigan	Lake Huron	Lake Erie	Lake Ontario
Beach Advisories	Unchanging	Unchanging	Unchanging	Deteriorating	Unchanging

Status:	GOOD	FAIR	POOR	UNDETERMINED
---------	------	------	------	--------------

Overview

Public beaches of the Great Lakes are open and safe for swimming an average of 96 percent of the season in the United States and 78 percent of the season in Canada. However, analysis of trends and comparison between countries is difficult because monitoring and criteria that support beach closing decisions vary across jurisdictions. In Canada, for example, Ontario uses more stringent standards that result in additional beach closings. This difficulty in comparing data was noted in the 16th Biennial Report by the IJC

in 2013, where the IJC recommended that the governments develop binational, standardized, basinwide surveillance and monitoring protocols and adopt binational standardized criteria for beach postings. Because recreation is a prime way that people identify with the Great Lakes, water quality monitoring at beaches and maintaining and improving healthy recreational opportunities is key to engaging the public in the protection of the Great Lakes.

Background

The public beaches of the Great Lakes and connecting waterways are a source of recreation to many of the 40 million residents of the basin and to tourists as well. Coastal and in-lake recreation in the Great Lakes has many benefits. However, swimming, boating and beach use also have the potential to adversely affect human health through exposure to biological hazards such as bacteria or viruses, which may be present in the water. Epidemiological studies have shown several adverse health effects, including gastrointestinal and respiratory infections, to be associated with recreational water in marine and freshwater systems polluted by human and animal waste. These effects can result in a significant burden of disease and economic loss. Sources of this fecal pollution include combined sewer overflows (CSOs), sanitary sewer overflows, urban and agricultural stormwater runoff, as well as septic system discharge and leakage.

Assessment

Determining the extent to which programs and measures are achieving the GLWQA's recreational use general objective is complicated by the lack of a specific corresponding annex that directly supports the implementation and reporting of programs to achieve this objective. Numerous GLWQA activities relate to beach health and indirectly work to protect and improve recreational water quality: work under Annex 1 includes improvement of beaches at Areas of Concern (AOC); recreational water quality is considered under Annex 2; lakewide management, and design and monitoring of the indicator for beach health to support SOGL reporting falls under Annex 10 (Science). However, this level of indirect attention is insufficient considering the importance of recreational water quality to the Great Lakes public.

YOUR VOICE

"I recently moved to the St. Catharines area and was pleasantly surprised that the Lake Ontario water at the Port Dalhousie Beach was clear. I even chose to swim in it last summer. I also swam at Crystal Beach in Lake Erie. Ten, fifteen or twenty years ago I wouldn't have dreamed of swimming in either of these two lakes. But, because of the monitoring and cleanup of the Great Lakes, I felt comfortable enough to submerge myself in these waters."

Suzanne V. Tilley, St. Catharines, Ontario, letter via email, March 31, 2017



As the PROP is organized around annex-by-annex reporting, there is little attention to swimming or the use of Great Lakes waters for recreation. The discussion of swimming and recreational water quality that does occur relates to the nutrients annex and Ohio, Pennsylvania and US federal actions to monitor and manage harmful algal blooms (HABs) and risks associated with the release of cyanobacterial toxins in recreational waters. Canadian action on the Hamilton Harbour AOC mentions improved recreational waters as a byproduct of AOC cleanup.

The Parties reporting on recreational waters and human health could be improved to address specific initiatives related to beach improvement and maintenance as well as the numerous activities under the different annexes that impact the quality of recreational waters and beach health. No provision currently exists for routine identification and reporting of emerging issues related to human health general objectives, and to coordinate annex activities related to recreational water and human health. For example, there is no connection made between recreational waters and the need to address sewer overflows. Also, the path for recognizing HABs as a recreational water issue and incorporating new HABs monitoring technologies into recreational water reporting under the GLWQA is unclear.

SOG reporting on recreational waters includes an indicator addressing the frequency of beach advisories in both countries. The indicator status and trends are reported for the basin overall and for each Great Lake. This reporting has two main weaknesses.

First, lake-by-lake assessments, which average indicator levels across an entire lake, do not give the public information about local beaches. The averaging obscures the positive impacts of local improvements and the negative impacts of compromised local water quality, thus preventing feedback to communities on successes or failures in their efforts to keep individual beaches swimmable. Mapping of beach closing data to show its spatial distribution around each lake should be pursued. Second, Great Lakes beach closures are determined by First Nation and Tribes, states, provinces and local governments. One jurisdiction's beach advisory statistics cannot be accurately compared to or averaged with those of another jurisdiction because consistency in monitoring and criteria do not exist. This makes trends difficult to interpret.

Improved focus and coordination to achieve the swimming and recreational water use objective could result in improved reporting on progress, better identification and examination of emerging issues specific to recreational water quality, and enhanced public understanding of the Parties' efforts to address recreational water use issues.

Canadian Great Lakes beaches that demonstrate they have met strict international criteria for monitoring and reporting based on applicable water quality standards and other education and management criteria can hold Blue Flag certification. The number of beaches achieving this certification in Canada increases each year. The Parties could consider and work toward a goal of achieving blue flag, or similar, certification at beaches throughout the basin.

Blue Flag Beaches

Blue Flag status has been awarded to many beach sites around the world. Blue Flag offers an attractive model for beach certification that promotes beach safety, environmental monitoring, and public communication of water quality to protect public health, using standardized activities and practices.

Blue Flag's emphasis on public outreach and education is instructive, and useful to consider given the challenges of effectively communicating beach status to visitors and residents of the Great Lakes basin in both countries.

In the United States, the Environmental Protection Agency (USEPA) implemented the health-protective Beach Action Value, which serves as a precautionary benchmark for making swimming safety decisions. A high exceedance rate of Beach Action Values indicates that coastal recreational waters are contaminated. Using this benchmark, the Natural Resources Defense Council (NRDC) reports that the Great Lakes region is consistently reported to be the US region with the highest percentage of beach water samples that exceed these recreational water quality criteria. The percentage of exceedance

for the Great Lakes narrowly surpasses other US regions, such as the Gulf Coast and New England, due in part to the high rate of criteria exceedance at Ohio beaches. According to the NRDC, chronically high bacteria counts indicate that beach water is probably contaminated with human or animal waste.

Indicators and monitoring

Given the lack of consistency in the indicator reported by the Parties, the IJC recommended two indicators in 2014 for recreational water that could be sub-indicators in the new SOGL structure. The first, *Risk of Illness from Great Lakes Beaches*, calls for continued measuring of *E. coli* levels in Great Lakes recreational waters. The second indicator, *Identified Risks at Great Lakes Beaches*, includes two measures: one supporting an assessment of the sources of contamination for Great Lakes beaches; and one to show how many beaches adhere to best practices by using a beach survey tool. While new indicator reporting will incur additional costs by the Parties, there are also significant costs associated with illnesses attributable to swimming and other activities at Great Lakes beaches.

The US Beaches Environmental Assessment and Coastal Health Act places a strong emphasis on bacterial monitoring for recreational waters. It requires all coastal states, including Great Lakes states, to develop programs for effective water quality monitoring and public notification of health risks at coastal recreational beaches.

All eight states in the Great Lakes basin have signed onto the act. These programs are implemented through state health or natural resources departments. Local and state health departments in the United States have experienced major budget and staff reductions since 2008, however, and funding for the act historically has been tenuous. Continued Congressional support is by no means certain.

In Ontario, the Safe Water Program requires boards of health to conduct surveillance of public beaches and assess factors and emerging trends related to illnesses and injuries. Ontario Public Health Standards for recreational water monitoring protocols are based on authority from the Ontario's *Health Protection and Promotion Act*. This approach presents challenges for the health units with limited funding because beach monitoring represents only one component of a wide-ranging mandate for public health.

Ongoing work by NOAA, the USEPA and the US Geological Survey holds promise for *E. coli* source tracking, predicting real-time water quality conditions and increasing the accuracy of beach closure notifications. These programs are particularly valuable given that the lag time in availability of *E. coli* data can be up to 24 hours, meaning that human exposure to unsafe levels of *E. coli* can occur when there is no advisory.



Conclusion

Great Lakes public beaches are open and safe for recreational use most of the time in both countries. Governments at all levels must strive to further improve safety and beach health. Given the importance of lake recreation to the Great Lakes public and to local economies, the Parties should increase their attention to recreational waters in GLWQA implementation. Standard monitoring approaches in both countries and adoption of indicators previously recommended by the IJC are steps that could improve reporting, protect beaches, and increase public safety when using Great Lakes beaches. Improved focus and coordination around achievement of the objective for recreational water use could enhance progress reporting on this topic, identify emerging issues specific to human health and recreational waters, and support policies and programs to create blue flag beaches, or its equivalent, throughout the basin.

3. CONSUMPTION OF FISH AND WILDLIFE

GENERAL OBJECTIVE 3

The Waters of the Great Lakes should allow for human consumption of fish and wildlife unrestricted by concerns due to harmful pollutants.

SOGL Indicator

Fish Consumption for the overall Great Lakes Basin: status fair, trend unchanging

Sub-indicator across the basin:

- *Contaminants in Edible Fish*: status fair, trend unchanging.



Summary of the status and trends of the State of the Great Lakes Fish Consumption sub-indicator and each Great Lake (Source: SOGL, 2017)

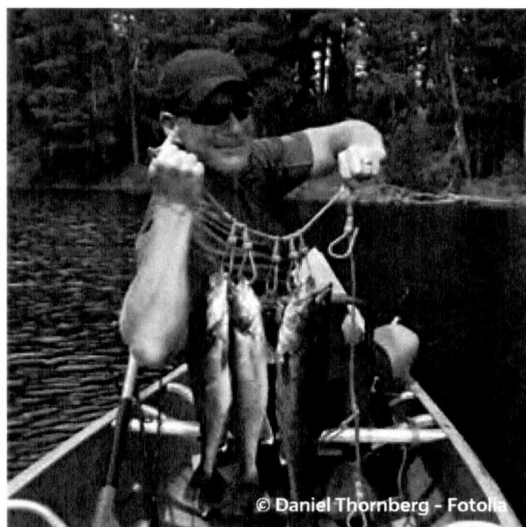
Sub-Indicator	Lake Superior	Lake Michigan	Lake Huron	Lake Erie	Lake Ontario
Contaminants in Edible Fish	Unchanging	Improving	Unchanging	Deteriorating	Improving
Status:	GOOD	FAIR	POOR	UNDETERMINED	

Overview

The Parties' efforts since the 1970s have resulted in steep declines in legacy chemicals in commonly consumed Great Lakes fish. However, fish consumption advisories remain in place for some species in all Great Lakes and a lack of standardized methodologies for collection, analysis and reporting of data across jurisdictions undermines creation of a reliable indicator.

Background

Many people in the Great Lakes basin consume fish from the Great Lakes. Legacy toxic substances and emerging contaminants have triggered health advisories recommending limited human consumption of some species in some locations. Fish consumption advisories exist for particular fish species in each of the Great Lakes. These advisories vary across the region and are most notable for long-lived top predators that have more fat, such as walleye, lake trout and salmon. Polychlorinated biphenyls (PCBs) are responsible for the majority of advisories, followed by mercury and dioxins.



Health advisories related to Great Lakes fish consumption are of greatest concern for those who consume large amounts of fish, such as subsistence anglers, many African Americans, indigenous communities, and some minority and immigrant communities, and those who are most vulnerable to the impact of toxic substances, such as women of childbearing age and young children.

Assessment

Differences in collection, analysis and reporting of data pose challenges in developing a Great Lakes sub-indicator on contaminants in edible fish to support the basinwide indicator for fish consumption. A common set of fish species, chemicals and standardized methods is needed for comprehensive SOGL reporting.

Fish consumption advisories for Canadian portions of the Great Lakes vary by lake and are related primarily to PCB levels and secondarily to dioxins or furans and mercury levels. Ontario has also developed a comprehensive fish consumption advisory program, including in recent years consumption advice for subsistence or frequent consumers (for example, a maximum of 32 meals per month). The US Environmental Protection Agency (USEPA) has published general guidance for fish consumption based on contaminant concentrations in fish tissues. State agencies also provide fish consumption guidance at their discretion and its distribution varies from state to state. However, concern remains about the persistence of contaminants in fish at elevated levels and their human health impact when consumed, either by high-volume fish consumers or populations that are susceptible to impacts from contaminants. Greater collaboration among federal, state and provincial agencies and Tribes, First Nations and Métis governments is needed on fish consumption guidance.

In 2014, the IJC recommended standardized methods to assess contaminant levels in the edible portions of fish for use as an indicator. The Parties have partially implemented this recommendation, reporting basinwide and lake-by-lake levels and trends for select contaminants in five species of top predator and sports fish deemed of interest for human consumption. The IJC continues to support the Parties' use of the new sub-indicator, contaminants in edible fish, but notes that broadening the emphasis of reporting beyond sports fish, as suggested by the IJC, would enable the inclusion of fish from

different trophic levels in the ecosystem that may be caught by a broader population of fishers. The IJC also supports binational methods and standards for determining the safety of Great Lakes fish consumption.

Both countries maintain long-running programs to examine levels of chemicals in Great Lakes fish commonly consumed by humans and there are multiple drivers for monitoring contaminants in fish. Data from Ontario's Fish Contaminant Monitoring Program, individual state monitoring programs, and results of the USEPA's 2010 Great Lakes Human Health Fish Tissue Study were used to screen edible fish portions for legacy and emerging contaminants across multiple fish species, which are included in binational Great Lakes reporting. However, differences in data collection, analysis and reporting pose challenges in developing a Great Lakes basinwide indicator for fish consumption. For instance, a common set of fish species and chemicals is needed for future data collection and assessment.

The only discussion of fish consumption in the PROP relates to the potential for exposure to persistent and bioaccumulative chemicals through fish consumption. No actions directly related to fish consumption are listed.

Greater focus and coordination around achievement of the objective for fish consumption could improve progress reporting on this topic, improve the standardization of data across jurisdictions, and improve communication of fish consumption advisories across the basin.

Communicating Advisories

Ensuring the proper communication of fish consumption advisories can be challenging. In 2004, the IJC's Health Professionals Task Force (now the Health Professionals Advisory Board) noted that 38 percent of fish eaters surveyed used only conventional sources of information, most often the media, when deciding whether to eat their catch. Jurisdictional fish advisories



should consider the perception of those being advised and site-specific data, as well as cultural and socio-economic factors. Agencies developing advisories aimed at restricting meals of local fish should keep in mind the social, cultural and health consequences of these advisories for First Nations, Tribes and Métis communities.

YOUR VOICE

"Fishing isn't like it was a century ago anywhere in the lakes, which reflects sickness in water... Subsistence fishing is essential for our people, we've changed which parts we feed our children to protect from contaminants, and we're trying to get the message out to more of our community about which fish are safe to eat. The size of fish have declined dramatically, which is a huge economic impact for the Native fishing industry."

Jennifer McLeod, Tribal Councilwoman, Sault Ste. Marie Tribe of Chippewa Indian. March 2, 2017, Sault. Ste. Marie, Ontario IJC Listening Session with First Nations and Tribes



An understanding of knowledge gaps in advisories along with message refinement and alternative outreach efforts are needed to increase compliance with fish consumption guidelines, particularly among subpopulations that exceed the guidelines frequently. A study of women of childbearing age who purchased fishing licenses in Great Lakes states found that one quarter exceeded fish consumption guidelines, with rates as high as 41 percent exceeding the guidelines in Michigan and Minnesota. Certain subpopulations who consume more fish such as women, older people and urban anglers, especially many African American and immigrant communities, may be at increased risk for exposure to potentially contaminated fish. Advisories to these communities may be best targeted by using locally based programs to communicate fish consumption advice.

Risks and benefits should be considered in decisions whether to consume Great Lakes fish. Fish supply healthy unsaturated fats and high-quality protein, but may contain contaminants at high enough levels to impact human health. Common alternative foods to fish may provide health promoting nutritional value, but also saturated fats or sugars and contaminants of their own.

Consumption of Wildlife

Although this GLWQA objective also addresses human consumption of wildlife unrestricted by concerns due to harmful pollutants, the PROP does not mention programs related to wildlife consumption. SOGL reporting does not connect human health with consumption of species dependent on Great Lakes waters.

Information regarding the widespread consumption of Great Lakes wildlife is limited and the level and spatial distribution of consumption patterns may not justify binational activities. Some Great Lakes states have active health advisories for certain game species of waterfowl and snapping turtles due to concerns over levels of contamination by mercury and organic chemicals such as PCBs.

Conclusion

Most Great Lakes fish are safe to eat if consumers follow guidelines from state and provincial agencies and First Nations, Tribal and Métis governments. When issued, more effort is needed to make people aware of advisories and concerns about the human health impact of contaminants in fish consumed at relatively high rates such as subsistence anglers and those vulnerable to contaminants such as women of childbearing age. Improvements in data collection, reporting and information sharing would help in discerning trends and communicating risks for contaminants found at levels of concern.

Recommendation

To improve progress toward the objective that the waters of the Great Lakes allow for human consumption of fish, the IJC recommends that:

- The Parties set a goal of reaching all populations vulnerable to health impacts from fish consumption with accessible and protective fish consumption advisories, and draw up a plan to do so. Populations include frequent consumers of Great Lakes fish such as subsistence anglers, many African Americans, indigenous communities, and some immigrant and other minority communities. It also includes those vulnerable to contaminants such as women of childbearing age and young children. In developing a plan to reach this goal, the Parties should collaborate more closely with representatives of these communities.

4. POLLUTANTS

GENERAL OBJECTIVE 4

The Waters of the Great Lakes should be free from pollutants in quantities or concentrations that could be harmful to human health, wildlife, or aquatic organisms, through direct exposure or indirect exposure through the food chain.

SOGL Indicator

Toxic Chemicals for the overall Great Lakes Basin: status fair, trend unchanging to improving.

Sub-indicators across the basin:

- *Chemicals in Great Lakes herring gull eggs:* status good, trend improving.

- *Toxic chemical concentrations in open water:* status good, trend unchanging.
- *Atmospheric deposition of toxic chemicals:* status fair, trend improving.
- *Toxic chemicals in sediment:* status fair, trend improving.
- *Toxic chemicals in Great Lakes whole fish:* status fair, trend improving.

Summary of the status and trends of the State of the Great Lakes Toxic Chemicals sub-indicators and each Great Lake (Source: SOGL, 2017)

Sub-Indicator	Lake Superior	Lake Michigan	Lake Huron	Lake Erie	Lake Ontario
Toxic Chemical Concentrations	Improving	Unchanging	Unchanging	Unchanging	Unchanging
Toxic Chemicals in Sediments	Unchanging	Unchanging	Unchanging	Improving	Improving
Toxic Chemicals in Great Lakes Whole Fish	Unchanging	Improving	Unchanging	Unchanging	Improving
Toxic Chemicals in Great Lakes Herring Gull Eggs	Improving	Improving	Improving	Unchanging	Unchanging
Atmospheric Deposition of Toxic Chemicals	No lake was assessed separately Great Lakes Basin assessment is Fair and Improving				

Status:	GOOD	FAIR	POOR	UNDETERMINED
---------	------	------	------	--------------

Overview

The IJC values the principle of prevention, so progress to prevent pollutants from entering the lakes weighs heavily in the Commission's assessment of the extent to which programs and measures are achieving objective 4.

Although the development of procedures and processes to nominate and scientifically review

chemicals of mutual concern (CMCs) was a positive step in the new approach to chemicals under the 2012 GLWQA, delays in identifying CMCs and the failure to complete binational strategies for action in the first three years of the Agreement means that no new binational actions to prevent the input of pollutants



into the lakes have been implemented. As governments work to target CMCs for action in the next triennial cycle, they should implement the GLWQA principles of zero discharge, virtual elimination, accountability and public engagement, as well as Extended Producer Responsibility.

Background

The Great Lakes are uniquely vulnerable to chemical contamination because they have a large surface area and flush slowly, which means many chemicals can enter the lakes via multiple pathways and collect in fish, wildlife and sediment. This is especially true for chemicals such as PCBs and DDT that build up (bioaccumulate) in the food web and break down slowly in the environment. Thus, chemical concentrations decline only gradually once controls are put in place.

Historically, intense industrial activities in the Great Lakes region and long-range atmospheric transport and deposition of chemicals from out-of-basin sources have contributed to chemical pollution of the Great Lakes. In addition to harming aquatic life, certain chemicals pose human health risks, primarily through consumption of contaminated fish.

YOUR VOICE

"The pollution of the Great Lakes and its detrimental effects on the populace are well documented and supported by scientific data. The longer we discuss without corrective action the larger the problem becomes...Inaction is equivalent to poisoning our offspring."

Jim Clark, Erie Pennsylvania, email,
January 24, 2017

The 2012 GLWQA introduced a new way of addressing pollutants. As opposed to addressing long lists of hazardous (and potentially hazardous) polluting substances as per the 1987 GLWQA, the 2012 GLWQA focuses action on chemicals of mutual concern (CMCs). CMCs are to be designated by governments, followed by the development and implementation of binational strategies for action.

Assessment

Levels of legacy toxic chemicals such as PCBs and dioxins are generally declining across the Great Lakes (Figure 1), yet levels of several new and emerging toxic chemicals such as the fire retardants dechlorane plus and hexabromocyclododecane (HBCD), which saw greater use after the phase out of another flame retardant, PBDEs, appear to be increasing. Mercury levels in some species of Great Lakes fish are stable or increasing but still well below levels of the 1970s.

During the first triennial cycle of GLWQA implementation, the governments developed a binational process for designating CMCs and selected eight chemicals (or chemical classes) in May 2016. The governments also created a process for public nomination of chemicals for consideration as CMCs. Nominations of radionuclides by the public and sulfates, lead and polycyclic aromatic hydrocarbons (PAHs) by government agencies are currently under consideration. Draft binational strategies for risk management for the first two CMCs (PCBs and HBCD) designated in May 2016 were not released until February 2017.

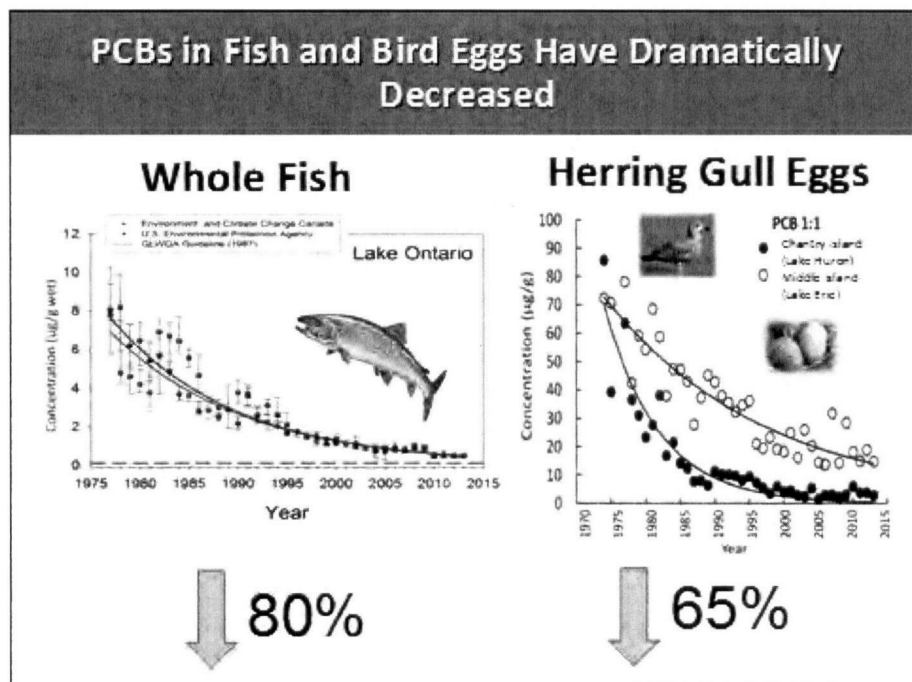
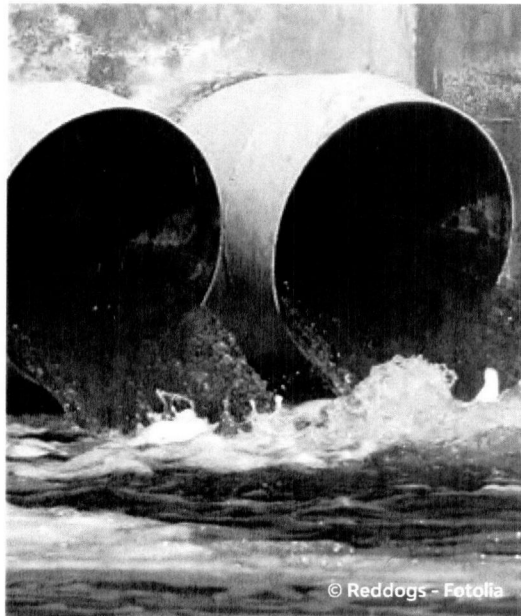


Figure 1. Levels of PCBs have declined in herring gull eggs and fish (Source: Draft State of the Great Lakes Report as presented at the Great Lakes Public Forum)



The Parties are to be commended for developing a binational process and designating the first set of eight CMCs under the GLWQA. This met their basic commitments under Annex 3. However, they fell well short of their own 2014-2016 priorities for science and action, which called for designation of the first CMCs in spring 2014 and completion of binational strategies for management by summer 2015.

Environmental organizations have expressed concerns to the governments and the IJC about the slow pace of the CMCs annex implementation. The IJC shares these concerns. Without strategies in place, there are no new binational actions to prevent chemicals from entering the lakes, though each country continues its individual efforts. Targets for strategy development and implementation must be set and met by the governments for each triennial cycle.

Looking forward to the development and implementation of strategies for action on CMCs, the IJC notes the principles of zero discharge and virtual elimination in Article 2 of the Agreement. The strategies developed must be aimed at implementing these principles for maximum protection of the lakes from persistent toxic CMCs. Lessons learned from past programs and initiatives related to virtual elimination and zero discharge, such as the Great Lakes Binational Toxics Strategy and Lake Superior Zero Discharge Demonstration Program, should be incorporated into the binational strategies developed for CMCs and used as a basis for discussion of the path towards achieving this general objective.

Implementation of zero discharge and virtual elimination principles for CMCs would also answer the many public comments received by the IJC calling for a chemical-free Great Lakes. Strategies must also contain clear timelines for the implementation of actions to put these principles into effect.

YOUR VOICE

"The Agreement's methodology for CMCs is simply impractical. With 80,000 chemicals in commerce and hundreds detected in the Great Lakes, it makes no sense to creep along a few chemicals at a time. The governments should carry out the Agreement mandate to eliminate all chemicals detected in the Great Lakes known to have or suspected of having toxic effects."

Michigan League of Conservation Voters, West Michigan Environmental Action Council, Lone Tree Council, letter via email, October 6, 2016

Moving toward zero discharge of CMCs means eliminating discharge of chemicals during manufacturing and industrial processes and addressing the release of pollutants into the Great Lakes throughout the life cycle of a product. The GLWQA's Annex 3 stresses the "importance of a life-cycle management approach."

In November 2016, based on the work of its Great Lakes Water Quality Board, the IJC issued a report to governments on PBDEs in the Great Lakes basin. PBDEs are a family of chemicals used as fire retardants and designated by the governments as a CMC. The IJC report recommended a combination of approaches to prevent and reduce the release of PBDEs during the life cycle of products containing PBDEs and during end-of-life management. While specific to PBDEs, these approaches can be adapted for other CMCs and their binational strategies.

In particular, the IJC report on PBDEs made recommendations regarding Extended Producer Responsibility (EPR). EPR is a policy approach in which a producer's responsibility for a new product extends to the post-consumer stage of its lifecycle. EPR shifts responsibility (fully or partially) upstream to producers and away from municipalities and provides incentives to producers to incorporate environmental considerations in the design of their products. Further work by the Water Quality Board in 2017 explored the concept of EPR with key Great Lakes stakeholders and recommended a cooperative approach to EPR, with government giving it the force of law if required for purposes of accountability. Such an EPR program should include products

made with alternative flame retardants and could become a model for EPR programs for other products containing toxins.

YOUR VOICE

"Adopting these principles [of EPR] for chemicals of mutual concern, as advanced in the [draft TAP] Report, would advance a prevention-first approach to managing chemicals that impact source water."

Erin Mahoney, Commissioner,
Environmental Services, The Regional
Municipality of York, letter via email, April 13, 2017



In Canada, the Canadian Council of Ministers of the Environment (CCME) established a Canada-wide Action Plan for EPR in 2009, with common coordinated policies, commitments for government action, and common key elements for building producer responsibility for priority products across Canada. Based on local needs and priorities, provincial governments also are responsible for developing regulatory approaches and setting performance measures and targets under the framework. Ontario and Quebec both have legislated EPR programs in place for electronics. Environment and Climate Change Canada has also identified EPR as a risk management option for products containing substances that are considered toxic under the Canadian Environmental Protection Act of 1999.

In the United States, state governments bear responsibilities similar to Canadian provinces to put in place legislation and implement EPR programs. US federal government action has largely focused on removing barriers to state initiatives. Opportunities exist for collaboration between Canada and the United States for joint identification and designation of products and materials for EPR action. The Canadian approach to EPR could be explored as a potential model for further implementation of EPR in the United States.

Review of Annex 3 implementation also demonstrates the need for more accountability and transparency in the work of the annex committee and how it makes decisions. Improved transparency will be especially important as the governments consider the public's nomination of radionuclides as a CMC and respond regarding their eventual decision. During IJC public input sessions, concerns about radionuclides and nuclear activity and the desire to have radionuclides designated as a CMC were heard repeatedly across the basin. The IJC also heard from the nuclear industry that radionuclides should not be designated as a CMC given the rigorous federal regulations, standards and licensing requirements for nuclear facilities that are already in place to protect human health and the environment. Independent of what the governments decide, the evaluation criteria and supporting information considered, the reasoning behind decision making, and any alternative or additional actions to be taken must be very clear to all concerned to maintain the integrity of the designation process and uphold the principles of the GLWQA.

Now that the public has been engaged in the implementation of Annex 3 through the public nomination of CMCs, the governments will need to think constructively and strategically about how this public interest is maintained and what it can bring to the CMC process.

Conclusions

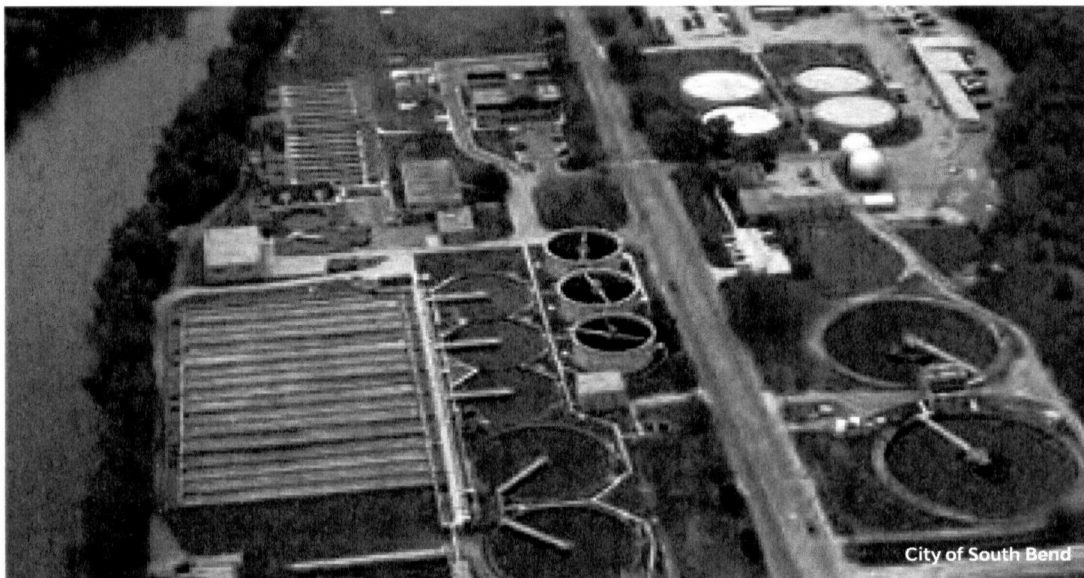
Progress in reducing levels of legacy chemicals is encouraging, but levels of emerging contaminants are of concern. Expediting the process to select CMCs and develop binational strategies for their elimination or control are among the most important improvements needed to meet GLWQA objectives. Strategies to address

CMCs need to be aimed at achieving zero discharge of these persistent toxic substances. Extended Producer Responsibility is an approach that should be further implemented in the Great Lakes basin to prevent pollutants from entering the Great Lakes during product use and disposal.

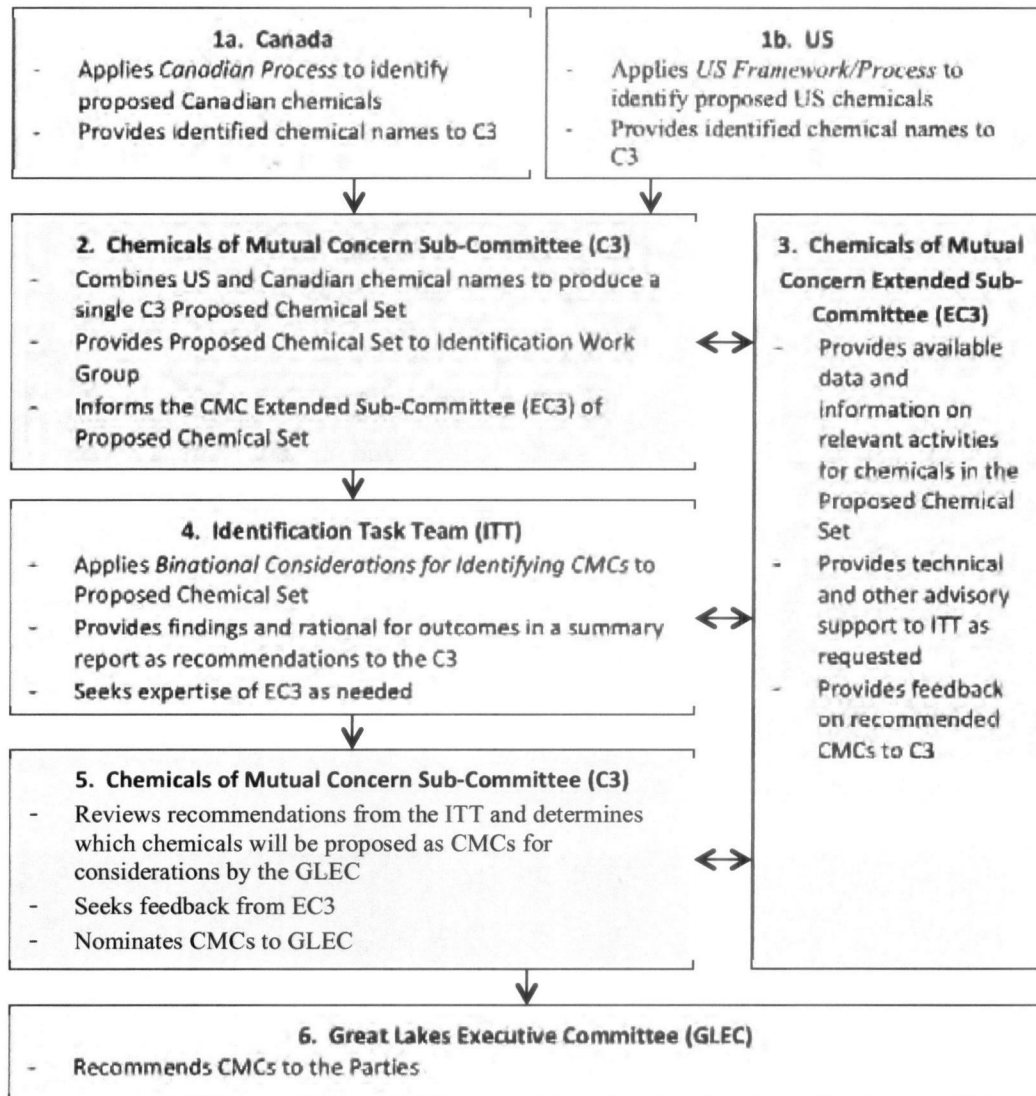
Recommendations

To improve progress toward achievement of the pollutants objective, the IJC recommends that:

- The Parties accelerate work on binational strategies for elimination or continual reduction of chemicals of mutual concern with clear timelines set and met for strategy development and implementation.
- The Parties develop strategies that have at their core the principle of zero discharge.
- The Parties adopt and extend policies and programs based on the principles of Extended Producer Responsibility (EPR) on a broad range of products, including flame retardants, to prevent introduction of toxic and non-toxic contaminants into the Great Lakes. The Parties should include status reports on EPR programs and policies in the triennial Progress Report of the Parties.



Summary of Annex 3's Process for Recommending Chemicals of Mutual Concern to the Parties



5. WETLANDS AND OTHER HABITATS

GENERAL OBJECTIVE 5

The Waters of the Great Lakes should support healthy and productive wetlands and other habitats to sustain resilient populations of native species.

SOGL Indicator

Habitats & Species for the overall Great Lakes Basin: status fair, trend unchanging.

Sub-indicators across the basin:

- *Coastal Wetlands*: status fair, trend unchanging.
- *Aquatic Native Species*: status fair, trend unchanging.

Summary of the status and trends of the State of the Great Lakes Wetlands and Other Habitats sub-indicators and each Great Lake (Source: SOGL, 2017)

Sub-Indicator	Lake Superior	Lake Michigan	Lake Huron	Lake Erie	Lake Ontario
Coastal Wetland Amphibians	Unchanging	Unchanging	Unchanging	Unchanging	Unchanging
Coastal Wetland Birds	Unchanging	Unchanging	Unchanging	Deteriorating	Improving
Coastal Wetland Fish	No lake was assessed separately Great Lakes Basin assessment is Fair and Improving				
Coastal Wetland Invertebrates	No lake was assessed separately Great Lakes Basin assessment is Fair and Deteriorating				
Coastal Wetland Plants	Undetermined	Undetermined	Deteriorating	Deteriorating	Unchanging
Coastal Wetlands: Extent and Composition	No lake was assessed separately Great Lakes Basin assessment is Undetermined				
Aquatic Habitat Connectivity	Improving	Improving	Improving	Improving	Improving

Status:
GOOD
FAIR
POOR
UNDETERMINED

Overview

The Parties have made important progress in addressing the general objective for wetlands and other habitats through implementation of the Habitat and Species Annex. Building on many years of experience, the Parties have made considerable effort to assess the status and trends of the health of the Great Lakes related to this objective and prepare useful SOGL indicator information. The development of binational habitat conservation

strategies is a significant contribution towards achievement of this objective. The ecological condition of wetlands can be improved through strengthening existing binational, domestic and local habitat restoration and protection programs, and supporting new initiatives.

The SOGL 2017 report shows that the overall trend of food web sub-indicators varies by lake, with some showing improvements and others deteriorating. Under the SOGL indicator for aquatic native species, lower food web

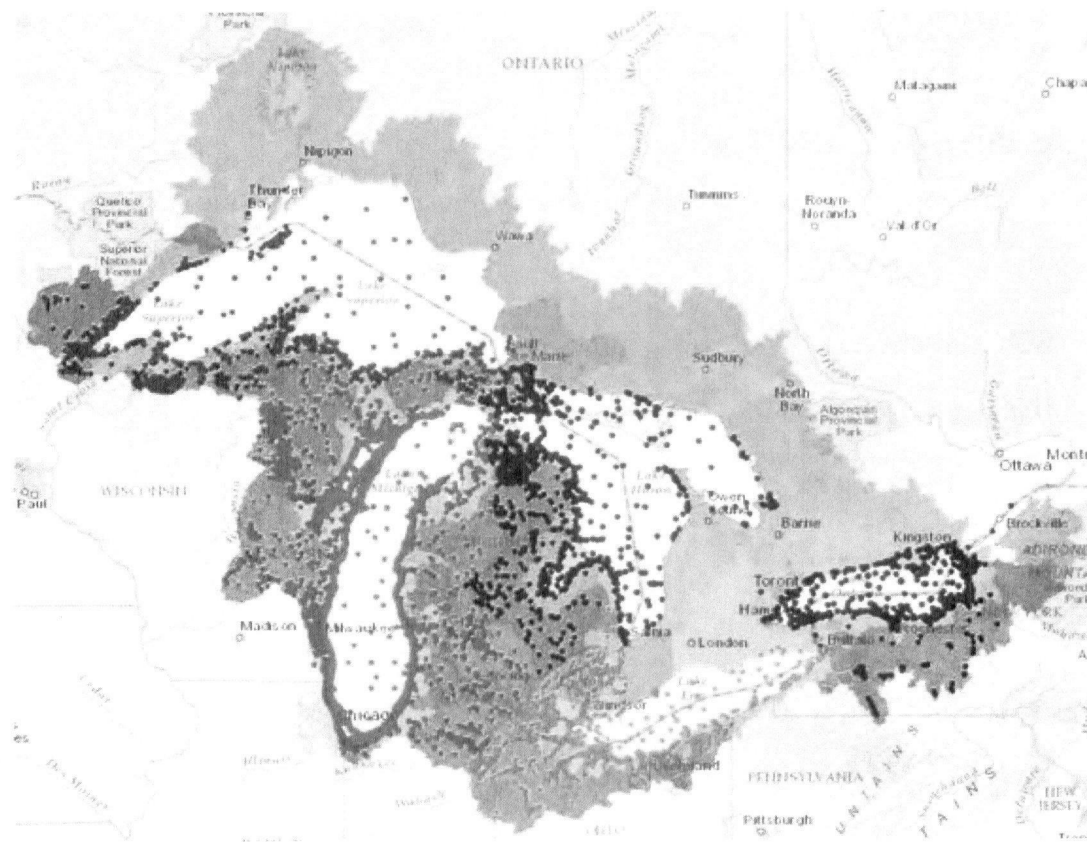


Figure 2: The USGS Science in the Great Lakes Mapper helps researchers and managers communicate, and analyze monitoring and restoration activities by providing easy access to project data. (Source: <https://sigl.wim.usgs.gov/sigl/>)

component sub-indicators (phytoplankton and *Diporeia*, a small shrimp-like crustacean) show a deteriorating trend in three or four of the lakes, whereas lake sturgeon populations are improving in all five lakes.

The Parties concluded that the overall health of coastal wetlands is unchanging, though no individual lake assessments have been conducted for coastal wetland fish and coastal wetland invertebrate sub-indicators. The extent and composition of coastal wetland sub-indicator is undetermined, although it

was estimated that over half of Great Lakes wetlands have been lost basinwide, with losses of up to 90 percent in some areas. Aquatic habitat connectivity is the only sub-indicator showing improvement for all five lakes.

Background

The Great Lakes consist of more than 121,406 hectares (300,000 acres) of coastal wetlands, 16,431 km (10,210 miles) of shoreline, 246,049 km² (95,000 mile²)

water surface area, and 22,925 km³ (5,500 mile³) water volume. These features provide critically important habitats for plants, insects, reptiles, amphibians, fish, waterfowl, water birds and mammals. Coastal wetlands also play an essential role in maintaining the health of Great Lakes aquatic ecosystems and improving water quality through the trapping and filtration of sediment and pollutants, and by storing and cycling nutrients and organic material derived from the land. Although healthy wetlands have always provided essential functions to support thriving plant and animal communities, their value has not always been understood and appreciated.

Other habitats such as non-wetland shoreline ecosystems and coastal tributaries and habitat features, such as connectivity to Great Lakes tributaries, coastal shoreline characteristics, lake substrates composition, water current movement and energy, and water quality and quantity, are also critically important to aquatic life, ecosystem function and human uses of the Great Lakes.

Assessment

The Parties' lakewide habitat and species protection and restoration conservation strategies have been important achievements in support of the objective for wetlands and other habitats. In addition, the Parties have developed a consistent basinwide approach for surveying Great Lakes habitat and measurement of net habitat gain.

To comprehensively measure coastal wetlands and the food web, the Parties used 16 sub-indicators. As a result, data collection and management is a key challenge to strengthening future assessments of progress towards this GLWQA objective. The data available for coastal wetland extent and composition assessment are the data generated in 2004 by the Great Lakes Coastal Wetlands Consortium, over 12 years ago. Hence, according to the SOGL report, the current areal extent and composition of coastal wetlands across the entire Great Lakes basin cannot be accurately



reported. An improved wetland data collection strategy is needed to ensure the detection of trends of this sub-indicator. Weaknesses in the current approach are associated with a reliance on short-term monitoring programs that are vulnerable to being discontinued, lack of standardized assessment methods, lack of continuity and transparency in data collection, and the absence of a mechanism for coordinating the data collection undertaken by various individuals and agencies.

YOUR VOICE

"We know so much about wetland values and ecosystem services whether it's flood mitigation, water quality improvement specifically related to phosphorus as well as carbon sequestration. Despite all of that knowledge, despite our collective efforts, we still lose wetlands."

Kevin Rich, Ducks Unlimited, IJC Public Comment Session at the Great Lakes Public Forum, Toronto, October 5, 2016

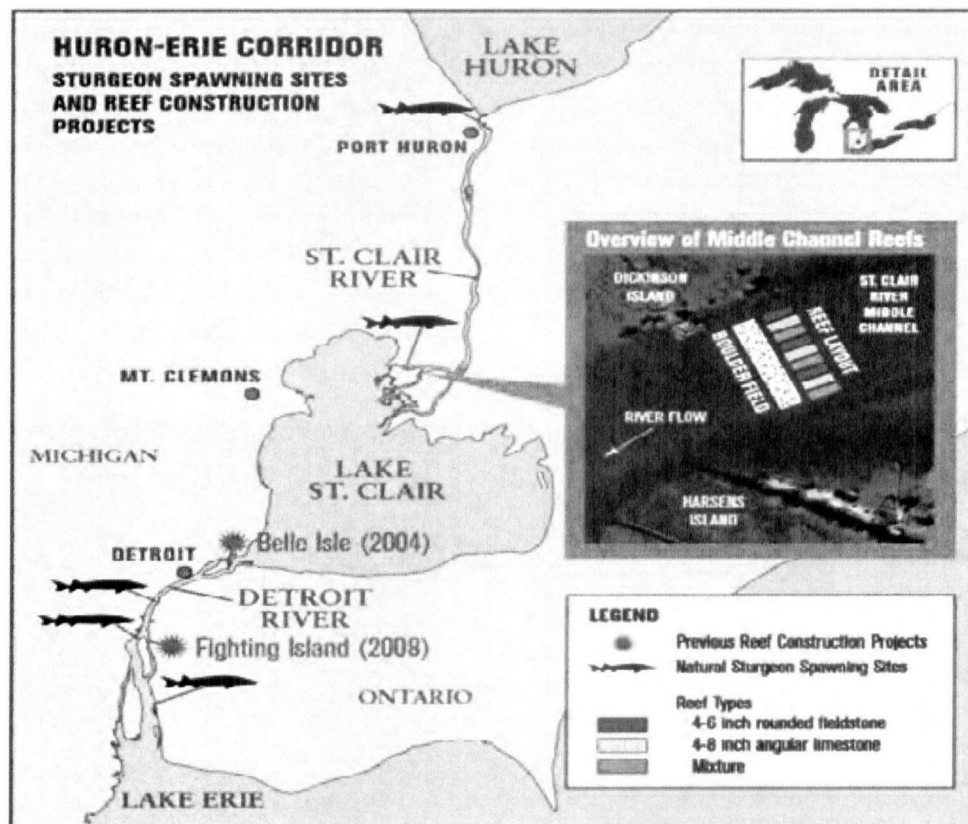


Figure 3: Habitat Restoration Huron-Erie Corridor Sturgeon spawning sites and Reef Construction projects (Source: http://www.habitat.noaa.gov/pdf/restoring_fish_habitat_in_the_stclair_river.pdf)

The Parties established the Habitat and Species Annex subcommittee and task teams in 2013 to address the above tasks. As reported in the PROP, the most significant achievements during the past three years are the development and implementation of lakewide habitat and species protection and restoration conservation strategies in each lake, and establishing a consistent basinwide approach to surveying Great Lakes habitat and measuring net habitat gain. The strategies, which have been developed for all five lakes as of 2015, assess the status and threats to lakewide biodiversity and recommend conservation priority for native species and their habitats.

The development of these surveys is a positive step for habitat and species protection. However, an effective data management system and coordination mechanism to facilitate sharing of survey data among partner agencies is needed.

In addition to their own direct work towards this objective, the Parties have facilitated a range of binational collaborative partnerships and programs in support of the Habitat and Species Annex, along with domestic and local collaborative programs. These partnerships have engaged federal, state, provincial, Tribal, First Nations, municipal government watershed management agencies and nongovernmental organizations. Opportunities are emerging from the annex process to promote and support new binational collaborative actions to reduce the loss of native species and habitat, recover populations of native species at risk, and restore degraded habitat.

The concurrence of the Parties with the IJC's Plan 2014 for the regulation of flows and levels through the Moses-Saunders dam at Cornwall, Ontario and Messina, New York will help to restore the diversity and health of the remaining coastal wetlands on Lake Ontario and the upper St. Lawrence River. These wetlands represent over 20 percent of the existing coastal wetlands covered by the GLWQA.

Further restoration activities to protect wetlands should involve the adoption of protective planning and zoning policies. Green infrastructure can also be used not just to protect wetlands but also start the process toward meeting the GLWQA's commitment to net habitat gain.

Conclusion

The Parties have done commendable work in developing habitat measurements and collaborating with a variety of actors in developing habitat conservation strategies. Further improvements in data collection and management could strengthen reporting and assessment of this objective. Recognizing the importance of maintaining existing wetlands and restoring degraded or lost wetlands, more efforts are needed to prioritize restoration activities and establish collaborations amongst all levels of government, indigenous peoples, stakeholders and nongovernmental organizations. Protective planning and zoning policies along with funding are also needed to ensure that coastal wetlands remain healthy.

6. NUTRIENTS

GENERAL OBJECTIVE 6

The Waters of the Great Lakes should be free from nutrients that directly or indirectly enter the water as a result of human activity, in amounts that promote growth of algae and cyanobacteria that interfere with aquatic ecosystem health, or human use of the ecosystem.

Draft SOGL Indicator

Nutrients & Algae for the overall Great Lakes Basin: status fair, trend deteriorating.

Sub-indicators across the basin:

- *Nutrients in Lakes*: status fair, trend deteriorating.
- *Cladophora*: status fair to poor, trend undetermined.
- *Harmful Algal Blooms*: status fair, trend deteriorating.
- *Water Quality in Tributaries*: status poor to fair, trend unchanging.

Summary of the status and trends of the State of the Great Lakes for Nutrients sub-indicators and each Great Lake (Source: SOGL, 2017)

Sub-Indicator	Lake Superior	Lake Michigan	Lake Huron	Lake Erie	Lake Ontario
Nutrients in Lakes	Unchanging	Deteriorating	Deteriorating	Deteriorating	Deteriorating
Cladophora	Unchanging	Undetermined	Undetermined	Undetermined	Undetermined
Harmful Algal Blooms	Undetermined	Undetermined	Undetermined	Deteriorating	Deteriorating
Water Quality in Tributaries	Unchanging	Undetermined	Unchanging	Unchanging	Unchanging

Status:	GOOD	FAIR	POOR	UNDETERMINED
---------	------	------	------	--------------

Overview

With the exception of Lake Superior, all Great Lakes are experiencing significant water quality issues related to nutrients. Due to excess phosphorus runoff from both agricultural lands and urban areas, soluble reactive phosphorus concentrations are above objectives in the western and central basins of Lake Erie, fueling record harmful and nuisance algal blooms. Similar symptoms of eutrophication are being observed in Saginaw Bay of Lake Huron

and Green Bay of Lake Michigan. As reported in the PROP, excess nutrients also undermine water quality in the nearshore waters of lakes Michigan, Huron and Ontario by supporting excessive growth of the nuisance algae, *Cladophora*, along shorelines and beaches. In contrast, open water total phosphorus concentrations are below target and show declining trends in lakes Michigan, Huron and Ontario. The probable explanation for this open water trend is alteration of the nearshore zone food web due to the proliferation of non-

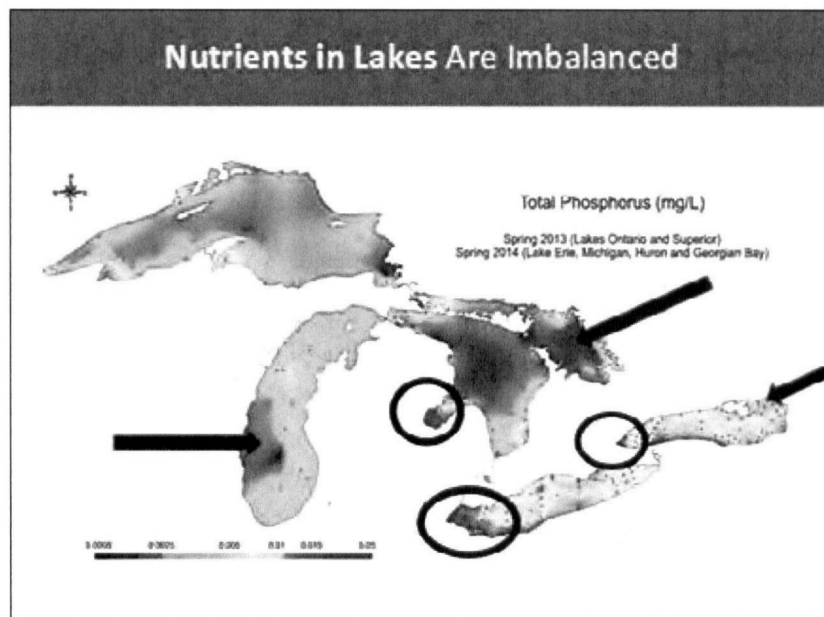


Figure 4: Imbalanced nutrient levels. Some areas are nutrient-rich (eutrophic) while others are nutrient-poor (oligotrophic). Differences have always existed, but they have been exacerbated recently. (Source: SOGL 2017 report)

native species that are sequestering nutrients and organic matter. This is undermining valuable fish populations that depend on a stable food web.

The Parties have made commendable efforts to develop phosphorus load reduction targets and to begin developing plans to reduce harmful algal blooms (HABs) and cyanobacteria biomass in the western Lake Erie basin and hypoxia (low or depleted oxygen) in the central basin. Work is also underway to develop phosphorus targets to reduce *Cladophora* in the eastern basin of Lake Erie. Attainment of ambitious phosphorus load reduction targets of 40 percent is unlikely without the addition of enforceable standards for agriculture and other sources to supplement voluntary stewardship.

Background

Phosphorus is the primary growth-limiting nutrient in the Great Lakes, as is the case in most temperate freshwater systems. Limits on phosphorus in detergents and improved wastewater treatment helped to make nutrient management a success story under the 1972 and 1978 iterations of the GLWQA. Total phosphorus loads and the occurrence of algal blooms declined, particularly in Lake Erie. However, since the mid-1990s excess phosphorus, especially the highly bioavailable fraction known as soluble reactive phosphorus or dissolved reactive phosphorus, has led to a recurrence of severe HABs, nuisance algae and hypoxia affecting nearshore zones and shallow embayments and basins of several of the lakes, particularly Lake Erie.

In 2014, the IJC issued a report entitled, *A Balanced Diet for Lake Erie: Reducing Phosphorus Loadings and Harmful Algal Blooms* under its Lake Erie Ecosystem Priority (LEEP). The LEEP report, as it is called, included 16 recommendations to governments for addressing nutrients in Lake Erie. Recommendations related to setting phosphorus loading targets, addressing agricultural and urban sources of nutrients, restoring wetlands and strengthening monitoring and research.

Assessment

The Parties have met the timetable they set in the GLWQA for establishing phosphorus load reduction targets for Lake Erie. The targets are for total and dissolved phosphorus to address harmful algal blooms (HABs) in the western basin and hypoxia in the central basin. The Annex 4 Nutrients Subcommittee responsible for development of these targets continues to work on phosphorus targets to address nuisance algal blooms in the eastern basin of Lake Erie. The subcommittee is also developing a strategy to achieve the anticipated nutrient reduction targets needed to control *Cladophora*. Efforts are also underway to develop concentration objectives and loading targets for phosphorus for Lake Ontario.

Domestic action plans

The Parties are also on track to meet the deadline to develop binational phosphorus reduction strategies and domestic action plans to identify and prioritize implementation measures to manage

phosphorus loadings toward these targets. Although the GLWQA deadline to develop these strategies and action plans is not until February 2018, there are two concerns about the process thus far. First, the Annex 4 Nutrients Subcommittee has not considered the possibility of recommendations for new regulatory authorities in domestic action plans. This is despite the fact that the GLWQA commits the Parties to “assess and, where necessary, develop and implement regulatory and non-regulatory programs to reduce phosphorus loading from agricultural and rural non-farm point and nonpoint sources.” New authorities – or at least the option of new authorities – could be critical to domestic action plans. Over the past ten to 15 years, governments at all levels have focused on incentive-based and voluntary programs to reduce nutrient loadings to the western basin of Lake Erie. These voluntary programs include funding and support for implementing best management practices on agricultural lands, the leading source of phosphorus in the western Lake Erie basin. However, frequent HABs in the last ten years suggest that the voluntary programs alone are not sufficient to achieve target loadings set by the Parties in 2016.

Second, the Annex 4 Nutrients Subcommittee has discussed endorsing plans developed by Ohio, Michigan and Ontario pursuant to their Western Basin of Lake Erie Collaborative Agreement as the state and provincial component of domestic action plans. The contention that these plans, in all cases, are sufficient to achieve the 40 percent phosphorus load reductions envisioned in the three-party agreement and the Parties' targets is not persuasive.



The success of the domestic action plans is critical to restoring water quality in Lake Erie and to protecting the waters for millions of people who rely on the lake for their drinking water. If domestic action plans are not sufficiently rigorous and rely solely on incentive-based and voluntary approaches, they are unlikely to deliver the phosphorus loading target reductions. The Parties have stated that they are evaluating existing programs in Canada and the United States to identify opportunities to maximize phosphorus reduction and may propose new programs or approaches to manage phosphorus loadings. Careful analysis of agricultural programs, especially the effectiveness of promoting voluntary adoption of best management practices, is critical.

The IJC further notes that domestic action plans need to include enforceable standards and regulatory actions. The plans must also show timelines for the implementation of actions, project leads, or teams responsible for expected deliverables and outcomes and quantifiable performance metrics in order to ensure accountability.

The PROP provides information about on-the-ground US activities during the first triennial cycle, especially on agricultural lands, and expected phosphorus loading reductions to be achieved. However, comparable detail is not provided for Canadian programs. The report also provides little discussion of declining nutrient levels in the open waters of most of the lakes, and no plans are provided to address the issue. The high nearshore nutrient levels and

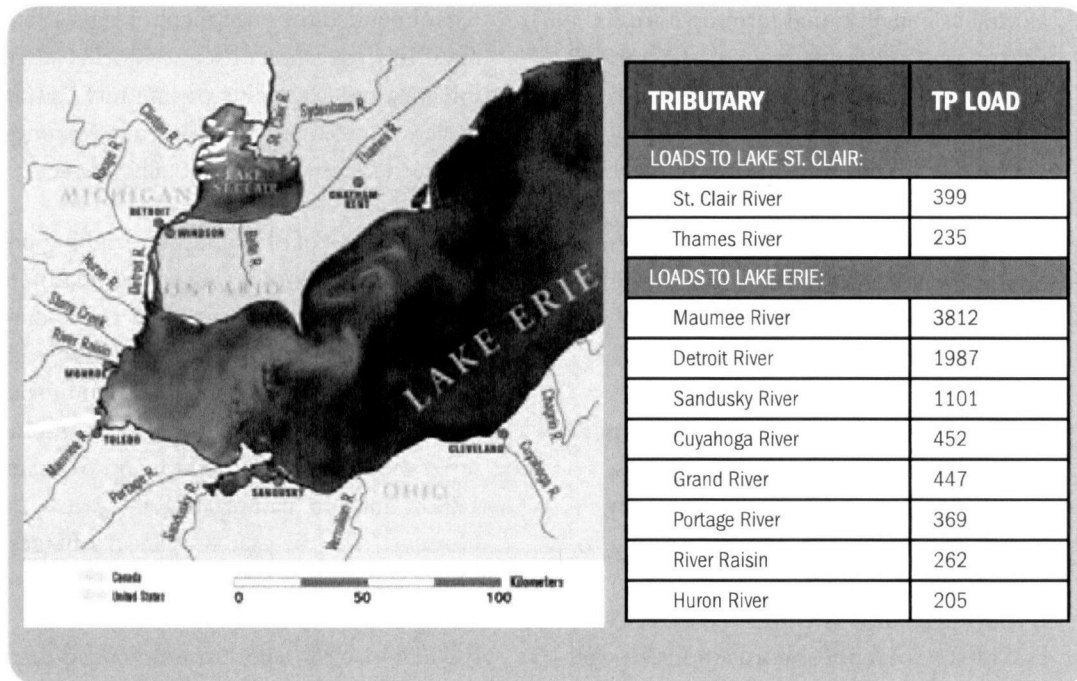
offshore low nutrient problem may be due to the establishment of abundant zebra and quagga mussel populations along coastlines that filter feed on phytoplankton in the water column, excrete bioavailable forms of phosphorus in the substrate of the nearshore, and thereby stimulate algal growth in the nearshore and reduce the flow of nutrients to the offshore. The low offshore levels affect the availability of phosphorus that can be incorporated into the food web, which ultimately can affect fish community composition and abundance.

Sources of phosphorus

Phosphorus loads to Lake Erie are not distributed evenly across the basin. Using data from the 2003-2013 period, the western basin receives the highest loadings: around 60% of the total load entering the lake, while the central and eastern basins receive 28% and 12%, respectively. Two of the largest watersheds that contribute nutrients to the western basin of Lake Erie are the Maumee River in Ohio and the Thames River in Ontario, which discharges into Lake St. Clair upstream of the Detroit River. The Maumee River phosphorus concentration is substantially greater.



Algae growth in Lake St. Clair from nutrient inputs from Thames River basin, which then flow into Lake Erie. (Source: NASA 2015)



Top 10 Contributors for 2008 – Metric Tons TP

Figure 5: Comparison of Total Phosphorus (TP) Tributary Loads to Lake St. Clair and Lake Erie
Sources: Michigan Sea Grant, M. Maccoux, Contractor ECCC, S. Wortman, USEPA, D. Obenour, NCSU, M. Evans, USGS.

The western basin of Lake Erie experienced a particularly severe HAB in 2011. The IJC 2014 LEEP report noted that half of the loadings to Lake Erie that year came from tributaries draining agricultural areas and rural communities. One of the major sources of nonpoint loadings of phosphorus to Lake Erie is agricultural operations, including the application of fertilizers and manures to the land. A significant source of nutrient inputs to the western Lake Erie basin is concentrated animal feeding operations (CAFOs). These are livestock confinement facilities that house large

numbers of animals, generating significant quantities of animal waste. The Sierra Club, Michigan Chapter reports that between the US states of Michigan, Indiana and Ohio there are 146 CAFOs in the watershed of the western Lake Erie basin, housing almost 12 million dairy, hog and poultry animals. Their estimated waste output is over 2,385 million liters (630 million gallons) annually.

Ohio legislation to curb the application of animal waste on frozen, snow-covered or saturated ground is a positive step towards reducing nutrient runoff from CAFOs

as well as conventional farm operations. Ontario's *Nutrient Management Act 2002* also prevents application of nutrients to agricultural land when the soil is snow covered or frozen. In addition to the designated CAFOs mentioned above, there are thousands of animal feeding operations operating in Ontario, Michigan and Ohio that do not require any permit registration with local authorities.

Fertilizers and manure are typically applied to the production of all types of crops, though the amount and type may vary by region and by crop type. According to a modeling study conducted by the US Department of Agriculture (USDA), over half of the total phosphorus input, as well as some of the highest rates of phosphorus application in the United States, are for corn and corn silage, the former averaging 30 kilograms per hectare (27 pounds per acre) and the latter 60 kilograms per hectare (54 pounds per acre). Approximately 71 percent of phosphorus applied to corn silage is in the form of manure. The same modeling effort found that both corn and corn silage also had the highest average phosphorus loss rate through runoff. This USDA study highlights areas where policy changes may have a significant, positive impact on reducing phosphorus loss from cropping systems.

Failing septic systems are considered to be a nonpoint source of nutrients to the Great Lakes. Maintenance of onsite septic systems and replacement of failing systems by homeowners are elements of proper stewardship. Recognizing the potential significance of this source of phosphorus to Lake Erie, the 2014 LEEP report

recommended the enactment of legislation requiring inspection of septic systems at regular intervals and expanding community education initiatives promoting homeowner awareness of the need for septic system maintenance.

Urban sources of phosphorus, including point source discharge from wastewater treatment plants and stormwater runoff and nonpoint source inputs from lawn and garden activities, can be significant. In 2011, direct point sources such as water treatment plants and combined sewer overflows accounted for approximately 16% of nutrient loadings to Lake Erie. However, over the past 40 years, discharges from most urban point sources have declined significantly. To continue this decline, the IJC 2014 LEEP report recommended that the governments work with municipalities to promote and accelerate the use of green infrastructure (such as filter strips, rain gardens, bioswales and engineered wetlands) in urban stormwater management in the Lake Erie basin.

Contributing factors

An unintended consequence of renewable fuels (or "biofuels") policies and mandates is the role they play in the eutrophication of the western Lake Erie basin and other basins and embayments of the Great Lakes that have predominantly agricultural watersheds. Ethanol is the main biofuel in the US and Canada, which creates strong incentives for corn production across the region. A high demand for corn ethanol may influence farmers to use more acreage to grow corn over other crops and intensify efforts to increase yields.

The USDA statistics on phosphorus inputs and applications rates noted above are evidence of intensive corn production. Biofuel policies that increase the demand for corn production to supply the ethanol industry are also stimulating demand by the livestock industry for silage.

The question is whether the environmental consequences of increased corn production can be mitigated by conservation practices. In northwestern Ohio, only five percent of Lake Erie's original approximately 125,000 hectares (307,000 acres) of wetlands remain. Similar patterns of wetland loss exist throughout the rest of the lake's western basin. The draining of coastal wetlands and most of the approximately 300,000-hectare (736,000-acre) Great Black Swamp in the Maumee River and Portage River watersheds "eliminated most of the capacity to prevent pollutants and sediments generated in the upland portions of the watershed from entering the lake," according to the Ohio Department of Natural Resources. Wetlands have proven successful in capturing and filtering pollutants such as nutrients from the water. Achieving the Lake Erie phosphorus loading targets will require substantial wetland restoration and construction.

There is no existing phosphorus daily load limit specific to the western basin of Lake Erie. The State of Ohio should, under the United States Clean Water Act, list the waters of the western basin of Lake Erie as impaired because of nutrient pollution. The State of Michigan has now done so. This would trigger the development of a tri-state phosphorus total maximum daily load (TMDL) involving those states with Indiana,

with US EPA oversight. The TMDL process entails calculation of the maximum amount of daily loading that the impaired waterbody can receive from both point and nonpoint sources and still meet water quality standards for the particular pollutant. Following development of a TMDL, its implementation should proceed in a way that meets water quality standards and restores impaired water bodies.

IJC activities

While making commendable efforts to fulfill their commitment under the GLWQA with respect to monitoring and modeling of phosphorus and other nutrients in the Great Lakes and their tributaries and connecting rivers, the Parties could enhance modeling with the measurement of nutrients at critical locations and specific times of the year.

Through its Great Lakes advisory boards, the Commission is investigating several nutrient-related topics that will result in advice to governments in the next triennial period:

- The Science Priority Committee of the Science Advisory Board has just completed an analysis of the relative influence of different agricultural sources of phosphorus (including commercial fertilizers and manure) in the western basin of Lake Erie.
- The Water Quality Board is examining policies related to confined animal feeding operations.
- The Research Coordination Committee of the Science Advisory Board is analyzing how progress towards phosphorus reduction goals can be measured and communicated in an adaptive management framework.

- The Science Priority Committee of Science Advisory Board is studying the juxtaposition between nearshore nutrient enrichment and declining offshore lake productivity.

In addition, the IJC is examining the influence of ethanol policies on agricultural nutrient loadings.

Conclusion

Excess phosphorus loadings are affecting the nearshore zones and shallow embayments and basins of several of the lakes. Critical problem areas include the western Lake Erie basin, Saginaw Bay of Lake Huron and Green Bay of Lake Michigan. While the Parties are meeting GLWQA deadlines for nutrient targets and domestic action plans for Lake Erie, a greater sense of urgency is needed. Additionally, inclusion of regulatory protections in draft and forthcoming domestic action plans is critical. Another problem requiring greater attention is the nutrient-poor (oligotrophic) conditions in the offshore of most lakes, which are affecting fish abundance and fisheries.



Recommendations

To achieve steep reductions in phosphorus loadings and harmful algal blooms and improve progress toward achievement of the nutrients objective, the IJC recommends that:

- Domestic action plans to achieve phosphorus loading reduction targets include details on the timeline, who is responsible for actions, and expected deliverables, outcomes and quantifiable performance metrics to assure accountability.
- The Parties further act on advice from the IJC's 2014 report on Lake Erie, most notably with respect to the need for enforceable standards governing the application of agricultural fertilizer and animal waste, along with better linkage between agricultural subsidies and farm operator use of conservation practices that are demonstrably effective at curbing phosphorus runoff.
- The State of Ohio should, under the United States Clean Water Act, list the waters of the western basin of Lake Erie as impaired because of nutrient pollution. The State of Michigan has now done so.
- Periodic testing be required and enforceable standards for maintenance and replacement of septic systems be instituted in the United States and Canada.
- All levels of government provide adequate resources to implement better stormwater management systems in urban areas and accelerate the use of green infrastructure.

7. INVASIVE SPECIES

GENERAL OBJECTIVE 7

The Waters of the Great Lakes should be free from the introduction and spread of aquatic invasive species and free from the introduction and spread of terrestrial invasive species that adversely affect the quality of the Waters of the Great Lakes.

SOGL Indicator

Invasive Species for the overall Great Lakes Basin: status poor, trend deteriorating.

Sub-indicators across the basin:

- *Impacts of Aquatic Invasive Species*: status poor, trend deteriorating.
- *Dreissenid Mussels*: status fair to poor, trend improving to deteriorating.
- *Sea Lamprey*: status fair to good, trend improving.
- *Terrestrial Invasive Species*: status poor, trend deteriorating.

Summary of the status and trends of the State of the Great Lakes for Invasive Species sub-indicators and each Great Lake (Source: SOGL, 2017)

Sub-Indicator	Lake Superior	Lake Michigan	Lake Huron	Lake Erie	Lake Ontario
Impacts of Aquatic Invasive Species	Deteriorating	Deteriorating	Deteriorating	Deteriorating	Deteriorating
Dreissenid Mussels	Unchanging	Deteriorating	Deteriorating	Improving	Deteriorating
Sea Lamprey	Improving	Improving	Improving	Improving	Unchanging
Terrestrial Invasive Species	Deteriorating	Deteriorating	Deteriorating	Deteriorating	Deteriorating

Status:	GOOD	FAIR	POOR	UNDETERMINED
---------	------	------	------	--------------

Overview

The introduction of invasive species has irreversibly changed the Great Lakes ecosystem. Preventing new invasive species and controlling or if possible eradicating existing species are amongst the biggest challenges facing the Great Lakes. In the 2012 GLWQA, Canada and the United States established annex committees to address aquatic invasive species (AIS) and ship source pollution (an important vector for AIS introduction). These annex committees acted to meet the priorities

for science and time-bound commitments established in the Agreement. The Parties have made significant progress in prevention, risk assessment, early detection and response planning for invasive species, committing extensive resources to the task. Most notably, the Parties have implemented vigorous, joint enforcement of requirements to exchange ballast and to flush empty ballast tanks with salt water prior to allowing sea-going ships to enter the Great Lakes. These requirements have proven successful in stopping the introduction of AIS to the Great Lakes from ballast water discharges

since 2006. However, with new invasive species threatening through other pathways and continued devastating impacts of the spread of invasive species already in the lakes, continued vigilance and binational action are required.

Background

More than 180 aquatic non-native species have become established in the Great Lakes due to human activities over the past 175

years. Most aquatic non-native species, such as Rainbow trout and Coho salmon, do not cause problems and some were intentionally introduced; however, about a quarter of the non-natives in the Great Lakes are considered invasive because they negatively impact the ecosystem, the economy, or human health. Aquatic invasive species such as sea lamprey and zebra and quagga mussels (i.e., dreissenids) have had basinwide, irreversible impacts on the Great Lakes ecosystem.

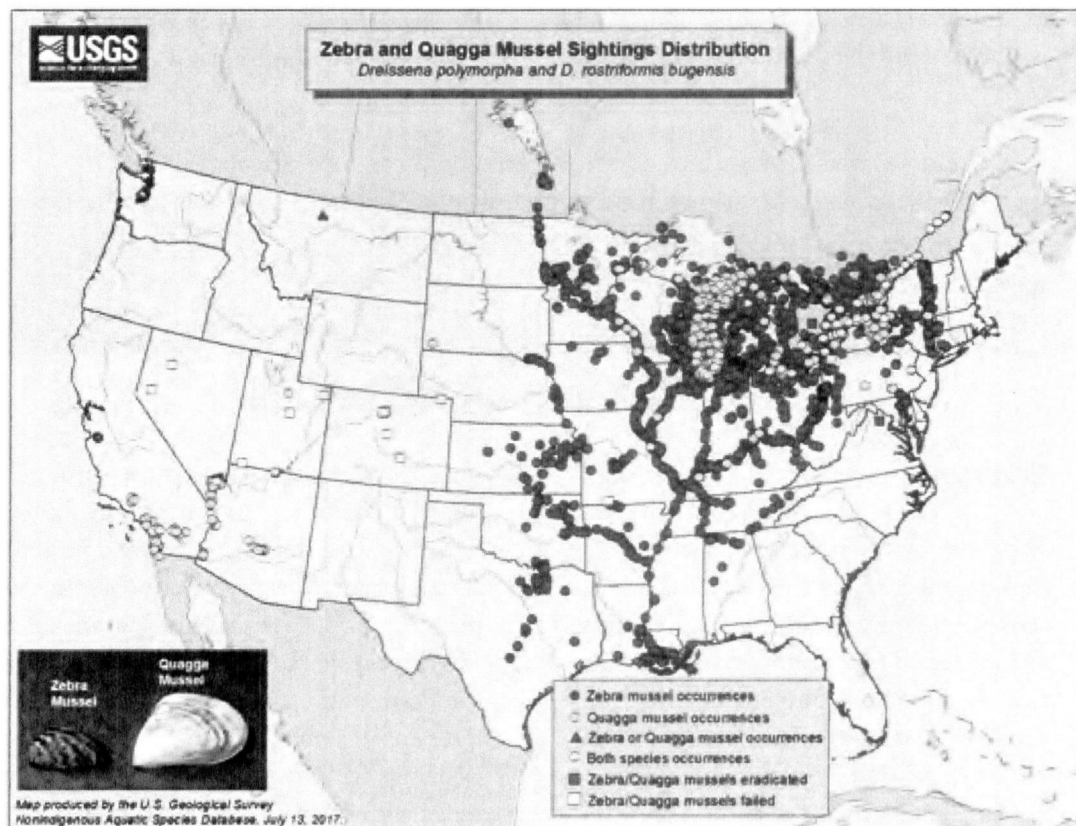


Figure 6: Distribution of Zebra and Quagga Mussels, Source: USGS

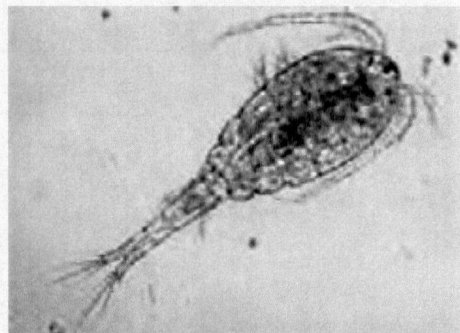
Terrestrial invasive species also affect the quality of Great Lakes waters through impacts to wetland function and changes to surface runoff.

Invasive species are among the toughest challenges facing the Great Lakes basin. They not only out-compete native species, altering food webs and habitats, but also exacerbate the spread of chemical contaminants and flow of nutrients in the Great Lakes ecosystem. Invasive species provide new mechanisms for magnifying and transmitting toxins to fish and wildlife, and concentrating nutrients in nearshore waters. Many other direct and indirect impacts are detailed in the SOGL technical report. The IJC has been reporting on the topic and providing a forum for binational collaboration on aquatic invasive species issues for over 28 years.

Assessment

Meeting the GLWQA objective for invasive species means stopping the introduction of new invasive species and successfully controlling the spread of existing species. The rate of discovery of new non-native aquatic species in the Great Lakes has declined sharply from an average of one new species discovered every eight months, with over 70 percent attributed to ballast water discharges, to no new discoveries of aquatic invasive species attributed to ballast water discharges since 2006. With the possible exception of a zooplankton species *Thermocyclops crassus*, no additional introductions from other pathways have resulted in establishment of a non-native species since 2006.

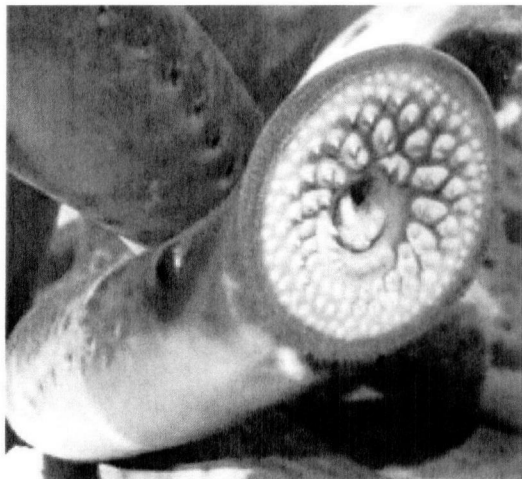
Thermocyclops crassus



USEPA

Thermocyclops crassus, a type of zooplankton referred to as a Cyclopoid copepod, was discovered in water samples taken from western Lake Erie in 2014. Numbers found indicated a small but established population exists in Lake Erie. The size ranges from 0.7 to 1.1mm in length (Fischer 1853). They are like a native cyclopoid copepod *Mesocyclops edax*, but slightly smaller. *Thermocyclops crassus* is present throughout Europe, Asia, Africa and Australia, but is generally considered Eurasian in origin (Ueda and Reid 2003). The species is considered to be non-native but not invasive.

This decline in new introductions can be attributed to the fact that both governments have mature invasive species prevention programs that are institutionalized in domestic legislation and regulations.



Sea Lamprey
Credit: US Fish and Wildlife Service

The Parties have instituted the most stringent ballast water management inspection regime in the world, taking into account the international ballast water discharge standard issued by the International Maritime Organization. These regulations require all ships entering the Great Lakes – St. Lawrence Seaway from outside the Exclusive Economic Zone (a zone extending out up to 200 nautical miles from the territorial sea) to conduct ballast water exchange or flushing. Both governments have coordinated enforcement programs to achieve nearly 100 percent compliance.

The IJC supports the joint efforts of the two governments to prevent the introduction of new invasive species through the strict enforcement of ballast water exchange and flushing requirements for seagoing vessels entering the Great Lakes through the St. Lawrence Seaway. Measures called for by Canadian, United States, state regulators and Tribes and First Nations to maintain

the strict enforcement regime of mandatory ballast water exchange and flushing, in addition to ballast water discharge treatment, would be a significant added measure of safety.

Even though the rate of new invasions has slowed, the impact of invasive species on the Great Lakes is identified as deteriorating because the spread of previously established invasive species across the lakes is having a negative impact on the ecosystem. For example, quagga and zebra mussels have increased in abundance over time and spread across the Great Lakes, with the exception of Lake Superior. They have effectively re-engineered the nearshore zone of many Great Lakes coasts and altered the availability of nutrients to offshore food webs in some of the lakes. Populations of *Diporeia* – an important link in the open water native food web – have plummeted while the growth of *Cladophora*, a nuisance alga, has benefitted from increased mussel populations and the corresponding increase in water clarity and nutrients they provide. These mussels have significantly changed the amount and types of phytoplankton available. Additionally, their filtering and nutrient excretion favors the production of cyanobacteria which may also lead to increased frequency, distribution and severity of harmful algal blooms.

To address the spread of aquatic invasive species, Transport Canada and several states are considering the regulation of ballast water discharges from “Lakers,” ships that remain within the Great Lakes. US Lakers are currently exempt from US Coast Guard ballast water requirements and are not

subject to the same regulations as seagoing vessels entering the Great Lakes – St. Lawrence Seaway system due to their unique operating characteristics, which currently makes ballast treatment challenging. Such characteristics include ballast capacity that may be three times larger and ballast pumping rates over ten times faster than seagoing ships, short voyages that are a matter of days, lack of tank coatings and less than one day in port. Instead, Lakers currently adhere to a set of best management practices required by USEPA's vessel general permit and founded on practices developed by the industry in 1993. Recognizing that Lakers may facilitate the spread of invasive species that are already present in the Great Lakes, any regulations should take into account the nature of Laker operations. The two federal governments have agreed to seek consistency and compatibility between United States and Canadian ballast water requirements in the 2017-2019 priorities for science and action, and this should provide a path towards harmonious joint implementation of regulations for Lakers and seagoing vessels.

The waters of the Great Lakes are also affected by the introduction and spread of terrestrial species. These species can cause an array of ecosystem impacts, including choking out native wetland plant species and deforestation leading to increased sediment, and chemical and nutrient loading to the Great Lakes. Sub-indicators associated with terrestrial invasive species include the species of common reed non-native to North America (*Phragmites australis*), Asian longhorned beetle, emerald ash borer, garlic

mustard and purple loosestrife. The poor status and deteriorating trends associated with the spread of previously established terrestrial and aquatic invasive species have overshadowed progress made in prevention of new invasive species, resulting in an overall SOGL status of poor and deteriorating.

Phragmites Infestation



Photo of *Phragmites* measuring up to 6 meters (19 feet) tall. (Source: Ontario *Phragmites* Working Group)

Prevention

To prevent newly introduced species from becoming established and spreading in the Great Lakes, the governments have initiated a first-ever aquatic invasive species warning system through the use of environmental DNA (e-DNA) for monitoring and detection. This innovation by the Parties has significantly improved the scope, frequency and number of target species for

early detection activities. Recent approaches to eradicate and control AIS include application of pheromones, chemicals, acoustic interference, carbon dioxide and electrical barriers. These approaches show exciting potential, but much more research is needed for field testing and implementation.

The use of information-sharing tools, including the NOAA Non-indigenous Aquatic Species database and the Early Detection & Distribution Mapping System used extensively in both the US and Ontario, have significantly improved the understanding of aquatic invasive species impacts and have helped to inform management actions. Significant investments have also been made in public outreach and education to address the spread of aquatic invasive species by activities such as recreational boats, bait fish, aquariums, and commercial and internet trade.

The IJC received significant public concern regarding invasive species and frustration that not enough is being done to prevent their introduction and spread. Species mentioned in particular were Asian carp, *Phragmites* and zebra and quagga mussels (dreissenids).

YOUR VOICE

"For invasive species, decisions should be based on science to get them out of the ecosystem. It's essential that Asian carp not enter Lake Michigan through Chicago."

Caroline Moellering, Little Traverse Bay Bands of Odawa Indians, IJC Listening Session with First Nations and Tribes, Sault Ste. Marie, Ontario, March 2, 2017



Asian Carp

There has been noteworthy progress in preventing Asian carp from entering the Great Lakes system. The Great Lakes Mississippi River Interbasin Study and Chicago Area Waterways Study have identified options for preventing the migration of Asian carp through canals and other interbasin connections. These options range from complete physical separation of the waterways, to less complex control measures aimed at eradicating invasive species as they attempt to move between the basins. Public comments received by the IJC on the draft assessment included many comments in support of closing the Chicago Sanitary and Ship Canal, although representatives of the marine transportation industry oppose physical separation of a navigable waterway. Although a final decision has not been made on Chicago waterways, other actions to close pathways between the Great Lakes and Mississippi systems are being put into place.

In particular, a physical barrier was constructed to eliminate the risk of AIS movement through Eagle Marsh, Indiana to the headwaters of the Maumee River and Lake Erie. This is a significant accomplishment that shut the door on what was a high-risk pathway to the Great Lakes. However, other potential pathways for carp to enter the Great Lakes exist. The challenge to control AIS was illustrated when it was confirmed in 2016 that Grass carp, a species of Asian carp, are spawning in the Sandusky River, a tributary of Lake Erie. Grass carp have also been discovered in Lake Ontario and the St. Lawrence River.

The work to keep Asian carp out of the Great Lakes has involved significant investments and strong collaborative efforts, within and between various government jurisdictions.

Phragmites

Common reed (*Phragmites australis*) may grow up to 6 meters (19 feet) tall and can quickly crowd out native wetland species by exuding a compound that kills the roots of neighboring plants. Its dense mass blocks light to other plants, changes wetland hydrology, alters wildlife habitat and increases fire potential. It spreads by seed dispersal and by the spread of vegetative fragments of rhizomes that break off and take root in new locations. ***Phragmites* was branded the worst invasive plant species in Canada by Agriculture and Agri-food Canada.**

YOUR VOICE

"Our biggest threat to our coastal areas right now are Phragmites. We are losing our habitat, we are losing our biodiversity, we are losing our species."

Janice Gilbert, Public Meeting on the Great Lakes, St. Catharines, Ontario, March 29, 2017

As shown in the SOGL reports, the distribution of this highly invasive plant has increased dramatically around the Great Lakes basin since 1961. The need for further binational collaboration on measures to control its spread becomes apparent when comparing United States and Canadian efforts to control invasive aquatic plants. While many chemical control agents are approved for use in the United States, only one is approved for use in Canada. Similarly, binational aquatic invasive species control efforts lack a shared or integrated approach to the safe and environmentally responsible use of all types of chemical, physical and biological control measures among jurisdictions.

The Parties are encouraged to find common ground on the safe and environmentally responsible use of all types of these measures. This includes harmonizing permitting and regulations, removing administrative barriers, adopting integrated hazard assessment and implementing critical path controls. For *Phragmites* in particular, chemical control used in the United States is not permitted in Canada, though trials are currently underway to evaluate chemical

use. In the meantime, this leaves manual cutting and drowning as the primary tools for control.

Comments received by the IJC during its public consultation process support providing resources to identify sources and locations of infestations, improve mechanical and chemical controls, and expand public awareness campaigns to share how invasive plants are spread and can be controlled. An intensive, well-focused, binational control and eradication program for effective basinwide practices and new tools that can control and eradicate *Phragmites* could draw public support. Such a program could identify new control technologies and methodologies that may be used to control and eradicate other invasive plants. It was notable that the comments about *Phragmites* as an invasive species came largely from Canadians.

Other “watch list species” are also getting closer to the Great Lakes, such as Tench (*Tinca tinca*), a fish found in the Richelieu River in Quebec, a tributary to the St. Lawrence River that may be moving upstream from the Quebec section of the St. Lawrence River.

Aquatic Nuisance Species Panel

The Great Lakes Aquatic Nuisance Species (ANS) Panel - With funding from the USFWS and staff support from the Great Lakes Commission, this panel plays an important role in preventing and eliminating invasive species in the Great Lakes region. The Great Lakes ANS Panel was created as a regional advisory panel for the U.S. ANS Task Force by the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990. The panel is binational, with members representing U.S. and Canadian federal agencies, the eight Great Lakes states and the provinces of Ontario and Québec, nongovernmental organizations, local communities, tribal authorities, commercial interests, and the academic community. Working with subcommittees of the Great Lakes Executive Committee, it helps achieve progress towards the goals established in the Great Lakes Water Quality Agreement. For more information see: <http://www.glc.org/work/glpans>.

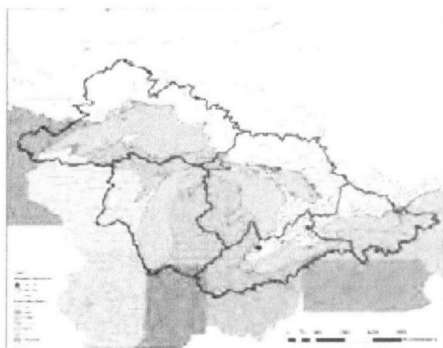


Figure 7. *Phragmites* Observations in the Great Lakes (1948-1961)

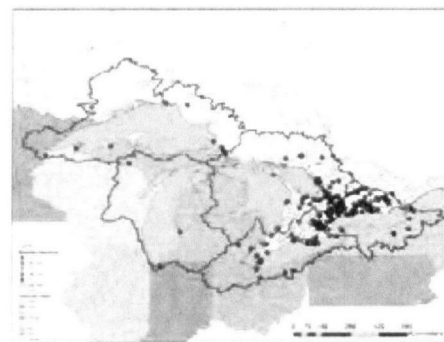


Figure 8. *Phragmites* Observations in the Great Lakes (1948-2015)

Source: SOGL 2017; EDDMapS

Progress

Much of the progress on invasive species made in the United States since 2010 can be credited to US Great Lakes Restoration Initiative (GLRI) grants. For the first five years of the GLRI, total expenditures for aquatic invasive species were US \$276.7 million for over 1,775 projects. This funding has included grants for Tribes to develop Great Lakes Tribal Aquatic Invasive Nuisance Species Management Plans. For example, in November 2016 the Grand Traverse Band of Ottawa and Chippewa Indians developed an AIS Management Plan to prevent and/or minimize the impact of AIS on the natural resources critical to the band.

Canada has also made significant investments in AIS initiatives with departmental funding from Fisheries and Oceans Canada, Environment and Climate Change Canada, the Ontario Ministry of the Environment and Climate Change, the Ontario Ministry of Natural Resources and Forestry, Canada's federal granting council Natural Science and Engineering Research Council, the nonprofit Invasive Species Centre and numerous other sources.

Most existing aquatic invasive species prevention and control programs continue to be funded and new collaborative efforts are focusing resources on specific vectors of invasive species movement and on high-risk species. Efforts to manage the discharge of ballast water, stop the spread of Asian carp, zebra and quagga mussels, and *Phragmites* and halt illicit trade of invasive species on the internet are models of multi-jurisdictional collaboration and innovation.

Leveraging the existing, extensive network of federal, state, provincial, First Nation and Tribal governments, local municipal agencies and nongovernmental organizations with deep AIS-related experience in annex implementation has been another reason for successes achieved in the first triennial cycle of the 2012 GLWQA. The need for effective multi-organizational coordination cannot be overstated. A 2012 study commissioned by the IJC found that in just a small portion of the Great Lakes basin, 100 Canadian and US public and nongovernmental organizations were involved in some way with AIS response. Close cooperation with the Great Lakes Panel on Aquatic Nuisance Species (ANS Panel) was a key element in harmonizing national and binational efforts through a network it developed over the past 25 years. The Parties' efforts and funding have resulted in an impressive list of accomplishments over the past several years.

However, funding for work on invasive species is largely on a project-by-project basis. There is little sustained base program funding for binational AIS monitoring, control and technology development in either country. Binational efforts to combat invasive species lack the important elements of certainty and long-term planning facilitated by uninterrupted program funding. A long-term strategic approach to combating AIS by moving to a sustained program funding model for binational AIS monitoring, prevention, control and technology development, would strengthen efforts.

The level of effort and funds spent on Asian carp control are well justified by the fact that programs have curtailed their spread. The



- next triennial reporting period.
- The Parties reach agreements on permitting the use of safe and effective control measures to reduce the spread of invasive species consistent across all jurisdictions within the next triennial reporting period.
- The Parties put in place long-term, sustainable funding mechanisms to support work on the fight against
- invasive species.
- Within the next triennial reporting period, the Parties invest significant resources to create an intensive, well-focused binational program for effective basinwide practices and new tools that can control and eradicate the threat of *Phragmites* and prove useful in controlling other invasive plants.

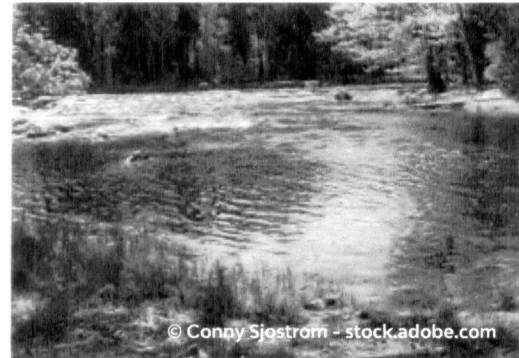
8. GROUNDWATER

GENERAL OBJECTIVE 8

The Waters of the Great Lakes should be free from the harmful impact of contaminated groundwater.

SOGL 2017 Indicator

Groundwater Quality for the overall Great Lakes Basin: status fair, trend undetermined.



Summary of the status and trends of the State of the Great Lakes for Groundwater sub-indicators and each Great Lake (Source: SOGL, 2017)

Sub-Indicator	Lake Superior	Lake Michigan	Lake Huron	Lake Erie	Lake Ontario
Groundwater Quality	Undetermined	Undetermined	Undetermined	Undetermined	Undetermined
Status:	GOOD	FAIR	POOR	UNDETERMINED	

Overview

The Parties have made excellent progress, completing a comprehensive report on groundwater science under the GLWQA and undertaking work on a groundwater quality indicator for future SOGL reporting.

Background

Groundwater in the Great Lakes basin is a critical part of the region's water resources, providing direct and indirect flows (as a

component of streamflow) to the Great Lakes. Groundwater and surface waters are inextricably linked in terms of quality and quantity (Figure 9). Reductions in groundwater quantity due to over-pumping, for example, can reduce base flow to streams, negatively affecting surface waters and degrading groundwater dependent habitats and ecosystems. Groundwater quality can be degraded by point and nonpoint sources of pollution such as leaking underground storage tanks, leaching from cropping and livestock operations and urban lands, and failing septic systems. Contaminated

groundwater can be a source of surface water contamination when it directly or indirectly discharges to the Great Lakes. Conversely, if groundwater is of higher quality than the receiving surface waters, it can enhance surface water quality.

The 2012 GLWQA includes an updated groundwater annex that recognizes the interconnection between groundwater and surface water and that preventing groundwater contamination in the Great Lakes basin is critical in protecting the

physical, chemical and biological integrity of the waters of the Great Lakes. The annex seeks to support the achievement of the groundwater general objective by promoting the coordination of groundwater science and management actions. There are still many gaps in the understanding of how groundwater affects the quality of Great Lakes waters, including the scale of groundwater discharges to the Great Lakes and the spatial distribution of known and potential groundwater contaminants.

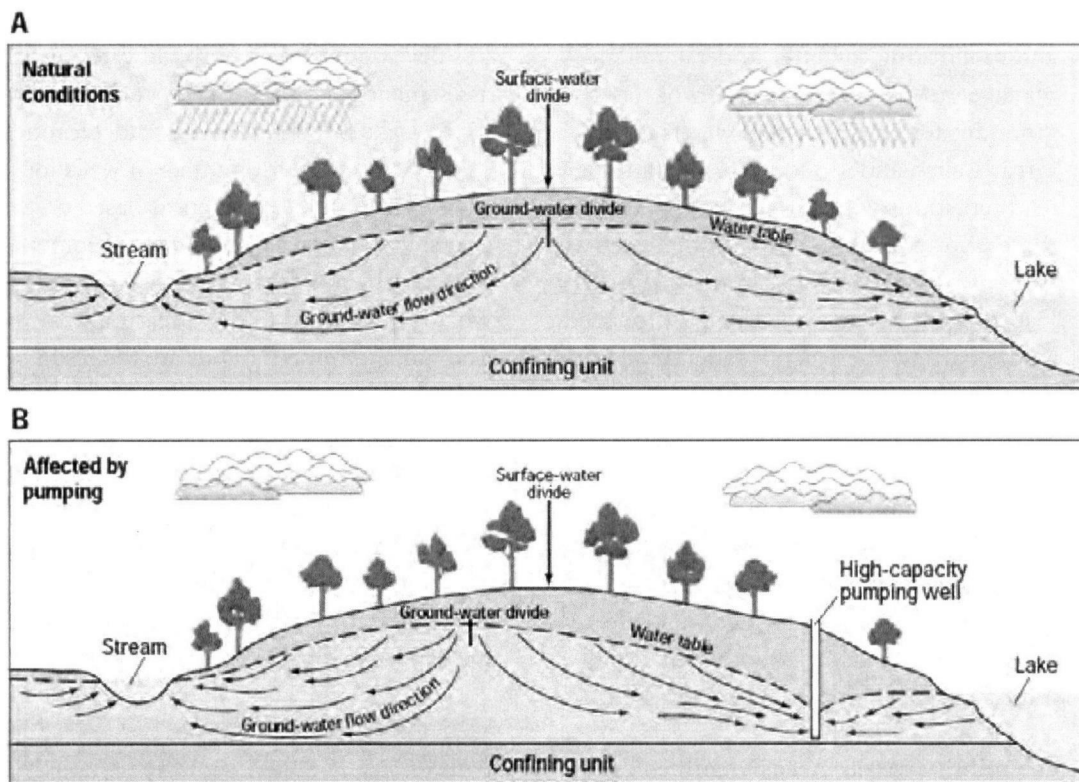


Figure 9: Generalized Groundwater - Surface Water Interactions (A) under natural conditions and (B) affected by pumping (Source: USGS, 2000)

Assessment

The Parties established five binational priorities for science and action for groundwater for 2014-2016. Three of these five priorities were accomplished with the release of the report on *Groundwater Science Relevant to the Great Lakes Water Quality Agreement: A Status Report* (May 2016), which examines threats and stresses to groundwater quality as well as the impacts of groundwater quantity and flows on the lakes.

The Parties' groundwater report identifies eight overarching priority science needs, including improved groundwater research and monitoring to better understand and manage groundwater quality; impacts of groundwater on the surface waters of the Great Lakes, and groundwater quantity and its interactions with surface waters. Three of these priority science needs are reflected as "actions" for groundwater in the *2017-2019 Priorities for Science and Action* produced by the Parties. These actions are: developing better tools to assess groundwater-surface water interaction; assessing the geographic distribution of known and potential groundwater contaminants; and advancing the monitoring and assessment of groundwater quality. However, it is not clear why these particular priorities were selected, nor is it clear when or how the remaining priority science needs will be addressed.

The priority science needs identified in the governments' Groundwater Science report are consistent with recommendations made in recent reports by IJC advisory boards and reports from the IJC to governments. In general, the reports identify the need

for improved groundwater research and monitoring to better understand and manage groundwater quality and subsequently its impacts on surface waters of the Great Lakes. This includes groundwater quantity and its connection to surface waters, which is not well understood.

According to the 2017 SOGL report, the overall status of groundwater quality in the Great Lakes basin is fair with an undetermined trend. In regions of the Great Lakes basin where there is more development (such as the basins of lakes Michigan, Erie and Ontario) the individual lakes are assessed as fair. Lake Huron, where there is less development, has a groundwater quality assessment of good. The status of groundwater in the Lake Superior basin is undetermined due to an insufficient number of wells for monitoring. This assessment is based on the available groundwater monitoring points in the basin and does not necessarily reflect what is discharged to the Great Lakes. The "undetermined" trends are the result of limited long-term groundwater data. Compared to previous SOGL groundwater indicators, the 2017 groundwater indicator more appropriately reports progress towards the achievement of the groundwater general objective by reporting on the quality of shallow groundwater in the basin, specifically the contaminants chloride and nitrate.



Future reporting of this indicator is expected to expand the number of parameters to be analyzed and the Parties are encouraged to consider the parameters proposed by the IJC as ecosystem indicators for groundwater.

The potential impacts of withdrawals on groundwater quality and ultimately the waters of the Great Lakes are increasingly important. The 2008 Great Lakes Compact and the parallel Great Lakes-St. Lawrence River Basin Sustainable Water Resources Agreement prohibit most new or increased diversions of water outside of the basin. If the compact and agreement are fully implemented, they will provide a solid foundation for managing Great Lakes diversions and consumptive uses into the future. Further, the IJC's 2016 *Protection of the Waters of the Great Lakes* report advocates that Great Lakes states and provinces fully factor the adverse ecological and water quality impacts of groundwater withdrawals into water use permitting procedures and decisions regarding consumptive use. For example, Michigan has developed a Water Withdrawal Assessment Tool to determine the potential impacts of large quantity water withdrawals on nearby water sources, including potential impacts to fish habitats and populations. This tool is currently being evaluated by other Great Lakes states for potential implementation.

YOUR VOICE

"I wish you would look at deforestation as a primary cause of groundwater pollution entering the waterways of the Great Lakes. In nature trees provide a cleansing effect. Every waterway in the Great Lakes watershed has experienced deforestation. The addition of impervious surfaces contributes to runoff."

Barry Johnson, The Greening of Detroit, Public Meeting on the Great Lakes, Detroit, Michigan, March 21, 2017

Conclusion

The Parties have worked diligently to identify scientific gaps in the understanding of connections between groundwater and Great Lakes water quality. The Parties are now working to close those gaps through the establishment of their 2017-19 Binational Priorities for Science and Action. Reporting on the status of groundwater quality in the Great Lakes basin has improved through the inclusion of groundwater contaminant levels.

9. OTHER MATERIALS, SUBSTANCES AND CONDITIONS

General Objective 9

The Waters of the Great Lakes should be free from other substances, materials or conditions that may negatively impact the chemical, physical or biological integrity of the Waters of the Great Lakes.

Several topics are included in this assessment, including Areas of Concern (Annex 1), Lakewide Management (Annex 2), the Cooperative Science and Monitoring Initiative (CSMI) (part of Annex 10) and microplastics.

Areas of Concern (AOCs)

Areas of Concern (AOCs) are locations where environmental impairments resulting from local human activities prevent certain uses of the lakes. These impacts are termed beneficial use impairments, or BUIs. Since AOCs were created by the governments under the 1987 GLWQA, 43 AOCs have been identified in the Great Lakes basin – 26 in the United States, 12 in Canada, and five that are binational and shared between both countries. Each AOC has a defined set of BUIs. When the governments can show that a BUI no longer exists, due in most cases to remedial action, the BUI is removed. When all the BUIs at an AOC are removed, the site is eligible for delisting (no longer being considered an AOC). AOCs can also be designated as “Areas in Recovery” while BUIs recover following the completion of all remedial actions. The tables below show the status of BUIs and AOCs across the lakes.

Beneficial Use Impairments

The 43 AOCs around the Great Lakes are locations where valued uses of the lakes could not be enjoyed due to specific environmental impairments. These are termed beneficial use impairments (BUIs). Fourteen types of BUIs are listed in the GLWQA. Two examples include restrictions on fish consumption due to contaminant concentrations, and loss of fish and wildlife habitat. Once all the BUIs that apply to a particular AOC are remediated and delisted (or removed), the AOC is considered ‘cleaned up’ and can be delisted (or removed) from the list of AOCs.



Table 9.1 Status of Beneficial Use Impairments

	Beneficial Use Impairments (BUIs)		
	Total number designated	Number removed	Number remaining
Canada	146	65	81
United States	255	62	193
TOTAL	401	127	274

Source: Progress Report of the Parties (2016)

Table 9.2 Status of Areas of Concern

	Areas of Concern (AOCs)					
	Total designated	Delisted	In recovery	Remedial actions complete but not yet delisted	Total with remedial actions remaining	Further areas expected to have remedial actions completed by 2019
Canada	12	3	2	1	6	2
United States	26	4	-	3	19	8
Binational	5	-	-	-	5	-
Canadian half	5	-	-	-	5	2
US half	5	-	-	1	4	1
Total	43	7	2	4+(1/2)	25+9(1/2)	10+3(1/2)

Source: Progress Report of the Parties (2016)

The greatest concern that the IJC heard from the public about the AOC program was the need to maintain government funding levels to continue this work. For example, at IJC consultations in Toronto, the IJC heard that progress in the Toronto Harbour AOC is contingent on substantial infrastructure investments. Resources are required to characterize and understand impairments, monitor recovery following implementation of remedial actions, and increase public and stakeholder awareness of remedial action plan (RAP) issues. Approximately one-third of the annual US \$300 million US Great Lakes Restoration Initiative funding has been directed towards AOC cleanup. Canada has made significant recent investments at the Hamilton Harbour AOC (CDN \$139 million, over approximately eight years for sediment remediation and CDN \$484 million, over approximately ten years, for wastewater treatment infrastructure) and the Port Hope Harbour AOC (CDN \$1.28 billion, over ten years for contaminated sediment remediation).



YOUR VOICE

"There's been much progress locally for addressing Areas of Concern. Moving forward, it's imperative that funding is provided to employ talented and dedicated professionals within the local/regional organizations to continue testing/researching, reporting, sharing data with organizations, pursuing improvements through legal channels, and engaging and educating the public and citizen scientists/volunteers."

Elizabeth Oldfield, Amherst, New York, letter via Participate IJC, April 4, 2017

Although base funding for AOC remediation through Canada's Great Lakes Action Plan has remained constant, investment in remediation activities also can occur through other programs such as the Investing in Green Infrastructure program announced in the Canadian Budget 2016. Increased investments by the Government of Canada in Canadian AOCs could further accelerate progress towards AOC remediation. The Remediating Contaminated Sediments indicator in the State of the Great Lakes 2011 report noted an increasing trend in remediation between 1997-2010, which is encouraging and reflects implementation of projects that were planned and permitted in earlier RAP processes.

This year, 2017, marks the thirtieth anniversary of the AOC program. It is now time for the Parties to look towards its completion. The Parties should assess the remaining BUIs and determine a management and funding plan to complete all necessary remedial actions in the next 15 years. BUI removal and AOC delistings can be maximized, in response to these actions, as the sites respond and recover.

AOC stakeholders and the numerous communities of practice associated with AOCs – including science and monitoring, project implementation and community engagement – would benefit from more meaningful opportunities for binational dialogue and interaction for technical transfer and coordination opportunities. Unlike all the other GLWQA annexes, no committee structure exists for the AOC Annex.

For the five binational AOCs, parallel domestic processes are in place and progress towards completion of management actions is generally uneven between them. This is inconsistent with the ecosystem approach principle included in the GLWQA. There is limited formal, contemporary guidance to inform BUI removal or site delisting in binational AOCs.

A report completed for the IJC in 2016 on 'life after delisting' found that several challenges exist for communities

transitioning beyond delisting. These challenges include a loss of momentum following delisting due to the absence of a tangible reason to organize, diffuse sources of funding for stewardship projects with uneven eligibility requirements, and less frequent environmental monitoring than existed prior to delisting, which in turn makes it more difficult to detect backsliding of environmental conditions. Additional support to public advisory councils and promotion of alternative funding and organizational models for environmental stewardship post-delisting would improve the likelihood that these local councils could successfully transition to other activities, such as playing an ongoing monitoring and watchdog role in the community and perhaps acting as a focus for local engagement in lakewide management.

YOUR VOICE

Much credit [for progress in addressing AOCs] should also be given to strong multi-jurisdictional cooperation and good science but the major reason for these successes is simple – money.

Healing Our Waters -
Great Lakes Coalition, Ann Arbor, Michigan
Participate! IJC, April 14, 2017

Although the public praised the action by governments on AOCs, they also often referred to AOCs as a cautionary tale. Large amounts of financial and human resources are now being spent to clean up errors from the past. To the extent that governments have avoided policies that could create new AOCs, they are to be commended. The Parties must remain committed and invested in prevention efforts and a precautionary approach to preserve the Great Lakes for future generations.

Lakewide Management

The IJC lauds the Parties for elevating the prominence of lakewide management in the GLWQA. The 2012 GLWQA includes lakewide management as a stand-alone annex, and assigns ambitious programs and measures to that annex. In 2015, the Parties released for comment the draft Lake Superior Lakewide Action and Management Plan (LAMP), the first LAMP issued under the current GLWQA. The LAMP was revised following a period of public input and the final Lake Superior LAMP was issued in September 2016.

Concurrent with LAMP preparation, implementation of priority actions in all lakes is ongoing. Projects focused on nutrient reduction, invasive species control and habitat restoration have received attention in Canada and the United States. Although these projects involve a diversity of partners and stakeholders, it is notable that nearly four years after the 2012 GLWQA came into effect, the LAMP partnerships have only recently established their outreach and engagement work groups to engage the public and affected communities.

In accordance with their Annex 2 commitments in the GLWQA, the Parties released a draft Integrated Nearshore Framework for review in March 2016 and a final framework in September 2016. The nearshore framework aims to identify nearshore areas of high ecological value or subject to high stress and identify the factors causing stress or threatening high value areas. Completion of the framework was the result of substantial efforts by the Parties and other partners. The guiding principles included in the framework are appropriate and comprehensive. Restoration and protection of sections of the coastline identified in the framework will require the allocation of adequate resources.

YOUR VOICE

"In 2006, our website attracted over 5,000 visits, we have over 600 subscribers to our newsletters... We have a tremendous amount of people who are interested and we can manage that, but we cannot do it alone. Without local AOCs, how will LAMPs be coordinated throughout the Great Lakes? Local advocacy will continue to be vitally important but will also be very challenging given the geographic expanse of the LAMPs."

Kris Lee, St. Clair River BPAC, Port Huron, Michigan, email, October 13, 2016

Nearshore Issues, Local Solutions

When the IJC held its public input sessions around the Great Lakes basin, it heard from many individuals, stakeholders and organizations about local water quality challenges in the nearshore area and along the tributaries that bring water to the lakes. However, there were also stories of local successes where local stewardship has greatly improved environmental quality. Turnout and participation in the IJC's call for public input showed the degree of interest and enthusiasm for Great Lakes protection and local action. The challenge is how to harness and focus this enthusiasm to move from a story of local impact to a story of local stewardship success.

A review of some of the local stewardship programs around the Great Lakes showed that the largest component of local approaches to nearshore improvements relies on knowledge transfer and educating communities about ways to mitigate nearshore water pollution and maintain coastal health. Informing local groups and individuals helps to foster a sense of responsibility and offers opportunities for "home-grown" action. It is also important to identify the socio-economic benefits that a healthy coastline has for the region. Objectives of such programs must be directly relevant to the immediate area in which they are being applied to foster local interest.

Pilot application of the Integrated Nearshore Framework between Long Point and Fort Erie, Ontario involved the integration of data from disparate sources to provide a cumulative assessment of the state of the nearshore waters. The datasets and visuals created to link stresses and threats to nearshore conditions and to assess change over time provide vital information to communities in the area and empower them to identify and create any needed change. In anticipation of the rollout of the Integrated Nearshore Framework across the lakes, the availability of funding programs to support local stewardship should be reviewed. Sufficient capacity is needed to support local interest in applying the knowledge and tools that the framework will provide.

Cooperative Science and Monitoring

The development of LAMP management activities relies heavily on science information developed through the Cooperative Science and Monitoring Initiative (CSMI). The CSMI coordinates binational priority science activities in the Great Lakes basin with an emphasis on enhanced monitoring and research field activities, which are conducted on the basis of one lake per year on a five-year rotating cycle. Such coordination reduces monitoring costs and focuses data collection efforts.

The CSMI is intended to complement ongoing monitoring conducted by the Parties in coordination with state and provincial agencies and others for various environmental components, including nearshore and offshore water quality, sediment quality and fish tissue contaminant concentrations. The CSMI focuses primarily on the lakes with limited focus on their associated connecting river systems. Given that these systems can act as sources of stressors to the downstream lake and modify in-lake processes, the binational lake partnerships and Annex 10 Cooperative Science and Monitoring Task Team should fully include the connecting river systems in the CSMI cycle.



The CSMI has significantly improved coordination among federal science agencies and some progress has been made coordinating involvement with state and provincial agencies. The encouraging progress made by the CSMI towards research and monitoring coordination could be built upon in other areas, including through partnerships with academic institutions. Reporting also could be improved through greater consolidation of findings as reporting is currently spread across various reports, articles and presentations. The consolidation of preliminary findings is needed on a timely basis to inform management decisions that follow the CSMI field year.

The year 2016 marked the ten-year anniversary of the CSMI's expansion to include research coordination in addition to the coordination of monitoring. Two cycles of the CSMI have occurred since then. Therefore, it is an opportune time to review the program and assess its success and the extent to which it has provided new data and information otherwise lacking or absent. As part of any review, the Parties should consider the need for adequate and dedicated funding for monitoring and research completed through the CSMI, given that understanding the lakes is critical to effective management.

Microplastics

Numerous studies have documented the presence of plastic debris, such as plastic bags, bottles, boxes, fibers, microbeads, and cigarette filters, in marine and fresh waters, including the Great Lakes. Larger plastic debris can

degrade into smaller particles. Particles smaller than 5-mm in diameter are known as microplastics. There are several categories of microplastics, including preproduction plastic pellets and flakes, microfibers, breakdown materials from larger plastics and microbeads. Microbeads, the most well-known of these categories, are small plastic beads that are added as an abrasive to personal care products, including cosmetics, face washes, toothpastes, deodorants, hair coloring, shaving creams and sunscreens.

These smaller plastic particles, the microplastics, are of special concern. Little is known about the fate of microplastics in the environment but they can foul aquatic habitats, can be ingested easily by organisms, and there is concern about their potential human health impacts through consumption of fish.

Though relevant under general objective 9, no annex or specific provision of any annex in the GLWQA explicitly addresses microplastics. However, one of the principles and approaches outlined in the GLWQA, the *precautionary approach*, does have implications for addressing the issue. The GLWQA defines precaution as set forth in the 1992 Rio Declaration on Environment and Development: "Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation." The potential impacts of microplastics on the Great Lakes ecosystem are significant enough to warrant action at the earliest possible opportunity.

Recognizing that the emerging issue of microplastics pollution in the Great Lakes was not adequately captured in the GLWQA, the IJC worked with governments at all levels, stakeholders and nongovernmental organizations in the Great Lakes basin to review the state of knowledge regarding the issue and develop recommendations that could be provided to the Parties. Following public consultation, the IJC's recommendations on microplastics in the Great Lakes were transmitted to the Parties under the Agreement headings of Binational Plan, Science, Pollution Prevention, and Education and Outreach.

Due to widespread knowledge of plastic pollution in marine waters, the Parties have undertaken several activities related to marine debris including researching, understanding and developing program and policy options to deal with microplastics. Efforts underway to address plastic pollution in the Great Lakes, such as NOAA's Great Lakes Marine Debris Action Plan, Alliance for the Great Lakes' Adopt-a-Beach program and the Great Canadian Shoreline Clean-up. These efforts and others, including banning single-use plastics and other Extended Producer Responsibility efforts, should continue to be promoted and supported as tools to prevent and reduce microplastic pollution.

In December 2015, the Microbeads-Free Waters Act became law in the United States. It prohibits soaps, body washes, toothpaste and other personal care products from containing the traditional plastic or biodegradable plastic beads as of July 1, 2017. The law also prohibits the sale of products containing microbeads as of July 1, 2019. In

November 2016, the Canadian government announced a ban on the manufacture and sale of shower gels, toothpaste and facial scrubs containing microbeads. The prohibition of the manufacture of these products comes into effect on January 1, 2018, with the prohibition on their sale beginning July 1, 2019.

The US and Canadian governments are to be commended for the great strides they have made addressing the issue of microbeads. However, microbeads are only a subset of the much broader issue of microplastics, which is a problem requiring more complex policy responses.

Recommendations

To address Areas of Concern, the IJC recommends that:

- The Parties set a goal of completing remedial actions for all Areas of Concern in the next 15 years, and maximize beneficial use impairment removals and AOC delisting during that time period.
- The Parties continue to advance implementation of remedial actions in all remaining Areas of Concern (AOCs) by maintaining recent Great Lakes Restoration Initiative investments in the United States and by accelerating cleanup at Canadian AOCs.
- The Parties enhance robust public engagement through the remedial action program by creating meaningful opportunities for binational dialogue between AOC stakeholders, and supporting public advisory councils when they transition to 'life after delisting' in their AOC.



6. ADVICE ON CRITICAL ISSUES

The GLWQA states that the IJC Triennial Assessment of Progress report may include “other advice and recommendations, as appropriate.” This chapter discusses and provides advice and recommendations on a number of critical issues that don't neatly align with a single GLWQA objective. These include implementation of the 2012 Agreement, human health, climate change, and engagement.



1. IMPLEMENTATION OF THE 2012 AGREEMENT

The Great Lakes are a precious resource shared by two great nations. Though each nation can work individually on the restoration and maintenance of the Great Lakes, they make the best progress when they work with each other and with their states, provinces and other orders of government, including indigenous governments. In a review conducted in 2006, the IJC found that the 1987 GLWQA was no longer an important driver for programs and actions in the Great Lakes. The 2012 GLWQA has addressed many of the gaps, deficiencies and issues associated with the 1987 version and provided innovative approaches and commitments across a much greater range of issues. More binational attention than ever before is being given to Great Lakes aquatic invasive species, habitats and species, and climate change, with full GLWQA annexes dedicated to these areas. This is in addition to annexes on topics such as pollutants and nutrients that remain of high importance to the lakes and the communities on their shores.

In this first triennial cycle of GLWQA implementation, the Parties devoted considerable effort to institutionalizing processes and procedures and meeting deadlines for initial GLWQA commitments. For example, the Parties successfully met deadlines for developing priorities for science and action, proposing a nearshore framework, and setting targets for Lake Erie binational phosphorus load reduction

targets. The first reporting cycle under the Agreement shows notable progress on accountability. Although the presentation and content of the Progress Report of the Parties (PROP) should be improved in future rounds of reporting to make it a better tool for public engagement, its creation and publication are praiseworthy.

YOUR VOICE

"Reports tend to be critical and make the case for where actions are needed or failures occurred. Ok, I can accept that as a method to push improvements. But we, must recognize success, we must build upon actions that have delivered, we must say thank you to the people and groups who have volunteered, please acknowledge the positives."

David Shortt, Samia, Ontario, letter via email,
March 27, 2017

Work under the Agreement is conducted through binational annex committees and task teams under the leadership of the Great Lakes Executive Committee. The PROP shows evidence of the extensive binational, interagency and intergovernmental cooperation on issues addressed in the GLWQA Annexes. Coordination with indigenous governments could be better demonstrated. On GLWQA objectives where specific annexes do not exist, such as the objectives for drinkability, swimmability and fishability, the degree of coordination, focus

and progress is not as evident. In the next triennial cycle of GLWQA implementation, the IJC will be looking to governments to build on the processes, procedures and institutions they have established to make greater strides in the restoration and protection of the lakes.

Recommendation

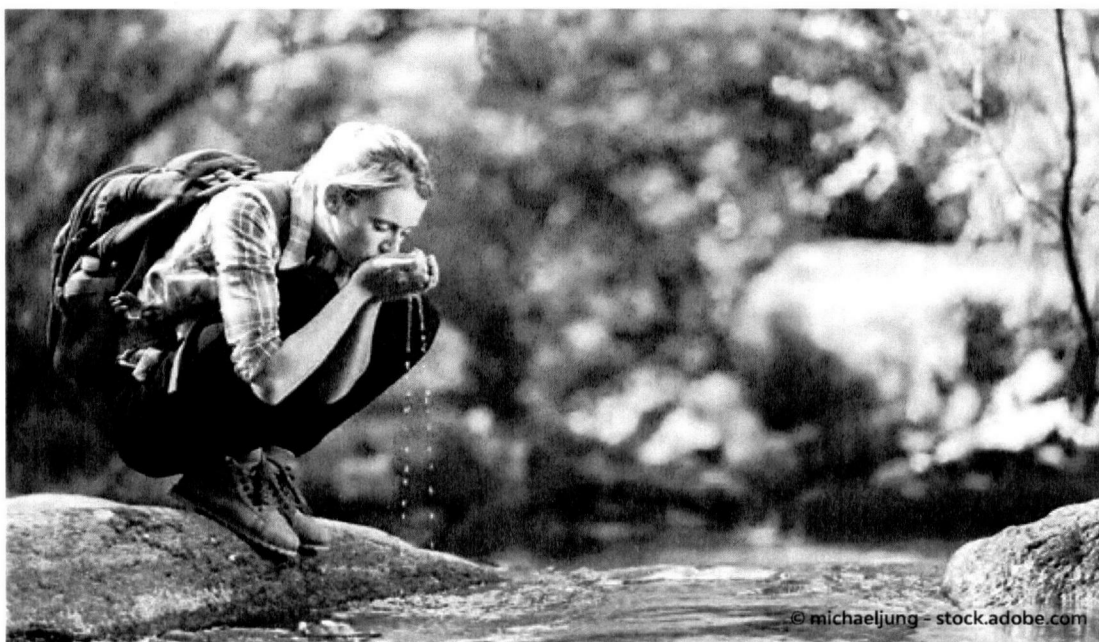
To continue and improve successes in GLWQA implementation, the IJC recommends that:

- The governments' financial investment in improving the water quality of the Great Lakes continue at current or higher levels.

2. HUMAN HEALTH

The Commission has consistently expressed concern about the need to increase attention to the human health implications of the quality of Great Lakes waters. In its 16th biennial report, the IJC observed, "One of the most vital concerns of the public is the safety or risk to human health of exposure to Great Lakes contaminants through

fish consumption, drinking water and swimming. Developing indicators of disease resulting from Great Lakes environmental exposures that reflect the best science and communicate meaningful information to the public is an important task for the governments." The 2012 Agreement refers to the importance of human health protection.



While the 2017 State of the Great Lakes report notes that many people benefit from the lakes that have high quality drinking water and open beaches, the Commission sees many areas that need additional work. The 2014 “do not drink” advisories by Toledo, Ohio and Pelee Island, Ontario in response to unsafe levels of microcystins in treated drinking water heightened the public’s attention to this concern. Long-standing boil water advisories in some indigenous communities, fish advisories to limit consumption to avoid toxic contaminants and beach closings after some storm events are evidence that more government action is needed to meet the Agreement objectives.

Yet the position of human health within GLWQA implementation is paradoxical. On the one hand, the Agreement sets three high priority human health general objectives often summarized as “swimmable, fishable and drinkable.” On the other hand, the GLWQA contains no annex dedicated to the coordination of implementation activities associated with these objectives.

YOUR VOICE

“We need to better connect human health and the impact it has on waterways and the environment; protecting the Great Lakes as a whole must also come back down to the household level.”

Syliva Orduño, Michigan Welfare Rights Organization and Member, EPA’s National Environmental Justice Action Council, Public Meeting on the Great Lakes afternoon roundtable, Detroit, Michigan, March 21, 2017

The Progress Report of the Parties (PROP) illustrates the lack of attention to human health issues in the GLWQA implementation in this first triennial cycle:

- Drinking water is discussed only in the context of nutrients, where actions by the federal government in the US, the State of Ohio and the Province of Ontario related to microcystins and harmful algal blooms are reported. Yet the GLWQA highlights the need to restore nearshore waters given that they are a major source of drinking water.
- There is little attention to swimming or the use of Great Lakes waters for recreation in the PROP. The discussion of swimming and recreational water quality that does occur is relative to the nutrients annex and it relates to US federal, Ohio and Pennsylvania actions to monitor and manage harmful algal blooms in recreational waters. Canadian action on an Area of Concern (AOC) mentions improved recreational waters as a byproduct of AOC cleanup.
- The only discussion of fish consumption in the PROP relates to the potential for exposure to persistent and bioaccumulative chemicals. No actions directly related to fish consumption are listed. The PROP does not mention programs related to wildlife consumption. As well, SOGL reporting does not connect human health with consumption of species dependent on the waters of the Great Lakes.



A greater focus on human health and improved reporting on domestic and binational actions related to the drinking water, recreational water and fish consumption objectives could foster better analysis of progress toward objectives achievement. Health data specific to exposures related to the waters of the Great Lakes should be collected and reported by ecosystem, as opposed to political boundaries. This would support analysis of connections between water quality and human health and be more likely to prompt appropriate action. Displaying the spatial distribution of impacts, such as beach closings, would facilitate public understanding and analysis of affected populations.

The IJC takes special note of the health implications of combined sewer overflows (CSOs). Combined sewer systems are wastewater collection systems that convey stormwaters, untreated sewage and industrial wastewater through a single pipe. These systems transport all the water to a wastewater facility for treatment before discharge to a water body. However, during periods of intense

rainfall or snowmelt, the volume of water collected by a combined sewer can exceed its capacity or that of the treatment plant. The systems will then overflow to a nearby water body from a CSO. These discharges can contain contaminants such as pathogens, sediment, toxics and nutrients. Discharges from CSOs can affect not just drinking water supplies, requiring greater and more costly treatment, but also the recreational use of the waters. Outflows from CSOs often result in the closure of beaches in order to protect human health. The size of the problem is shown by the fact that in one year, 20 Great Lakes cities in the US and Canada released a combined total of 92 billion gallons of untreated sewage and stormwater to the Great Lakes mostly via CSOs.

"No garbage, excretia, manure, vegetable or animal matter or filth shall be discharged into or be deposited in any of the lakes, rivers, streams or other waters in Ontario, or on the shores or banks thereof."

-Ontario Public Health Legislation, 1906

“Civilized people should be able to dispose of sewage in a better way than by putting it in the drinking water.”

-Theodore Roosevelt, 1910

Constructing and maintaining public infrastructure adequate to prevent these impacts is one of governments' most basic – and expensive – responsibilities. Meeting the costs to maintain and update these systems is a major challenge. Infrastructure investments will continue to place considerable demands on public budgets and planning for future needs is essential. Ensuring the adequacy of existing infrastructure to meet GLWQA objectives for future generations and assessing anticipated costs to provide this infrastructure requires continual attention from governments. Additional stressors such as more frequent and intense storm events due to climate change and cyanotoxins in source water affected by algal blooms further compound this challenge.

In the Great Lakes states, 184 communities have combined sewer systems and permits to discharge their overflow to surface waters, with eight of these communities discharging directly to the Great Lakes and the remainder to a tributary of the lakes. The highest densities of CSO communities in the United

States are found in the Lake Erie and Lake Michigan basins, with 92 and 72 communities, respectively. Ontario has 107 combined sewer systems. No new combined sewer systems have been permitted in Ontario since 1985. The IJC recognizes that the considerable time and money required to end CSO discharges of sewage to Great Lakes waters means that ending this risk to human health cannot happen immediately. However, plans need to be put in place now and adequate funds allocated to ensure that the end of these discharges is in sight. Zero discharge of inadequately treated or untreated sewage into the Great Lakes needs to be achieved.

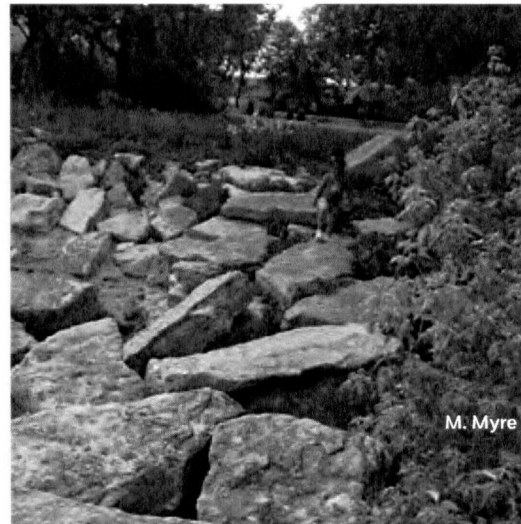
“We hold almost a quarter of all the fresh water in the world. And yet we are having problems with quantity and quality. That's ridiculous and it's fixable.”

-Bob McDonald

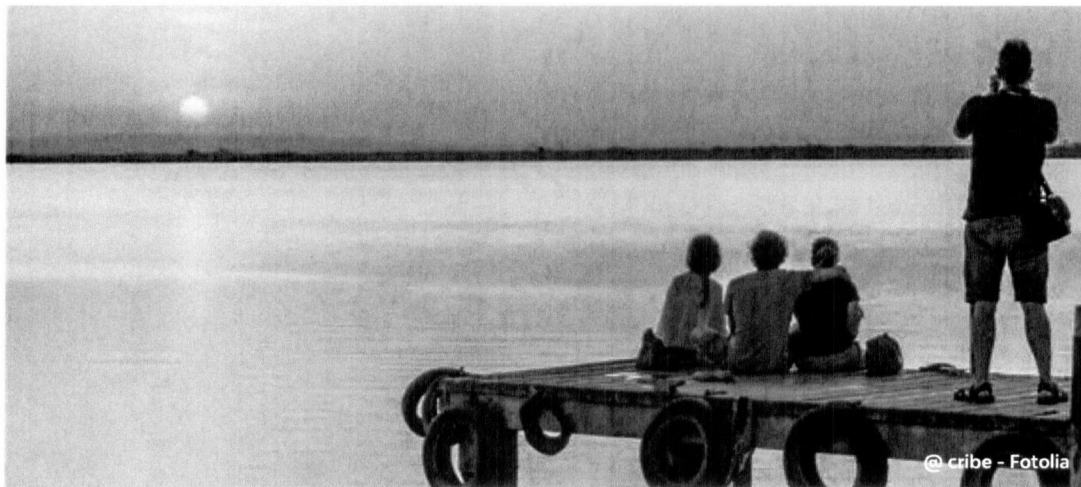
Both governments invested heavily in infrastructure in the 1970s, which led to significant improvements in water quality. In Ontario, infrastructure investments waned in the 1980s and 1990s but have been accelerated since the early 2000s leading to some recovery in the average age of municipal wastewater infrastructure and sewers and significant recovery in the average age of municipal water supply infrastructure. The United States has not experienced the same level of recent spending on Great Lakes water and wastewater infrastructure. However, in both countries infrastructure spending needs exist and it is encouraging to note that both governments have taken steps to identify the capital needs to improve drinking water and wastewater infrastructure. A return to the former level of investment by the Parties, as well as steps to reduce the burden from municipal governments, would be welcomed.

As communities try to address the issue of storm overflows in the face more frequent and intense storm events due to climate change, the burden on steel and concrete infrastructure can be reduced through the use of land use planning, zoning and green infrastructure. These tools can decrease the volume of storm runoff and increase the time it takes for stormwater to reach the sewerage system. Applying these tools has the potential to reduce the necessary capacity, and therefore the costs, of traditional infrastructure approaches to eliminating overflows.

Meeting challenges related to new development and climate change is not just about steel and concrete infrastructure.



Land use planning and zoning are also tools that can be used to prepare for and manage current and future challenges. Land use planning creates goals for how communities develop into the future, based on analyses of a community's present and future needs. Well-developed land use plans can protect a community's environmental and human health, implement robust infrastructure plans, and promote economic development. Land use plans also guide the development of zoning ordinances, which provide the legal framework to regulate land use. Zoning ordinances establish permitted land uses, differentiate between different land use types, and ensure that incompatible land uses are not located next to one another. For example, zoning ordinances can set restrictions on building on flood plains or wetlands, which can support a community's land use planning goal of improving resiliency to severe storm events and protecting residents' safety.



When used together, land use plans and zoning ordinances can protect the health of the communities' environment and its residents. These tools can be used to achieve goals such as decreasing the volume and increasing the quality of stormwater runoff to the lakes and helping coastal communities adapt to changes in lake levels.

Recommendations

To improve progress toward achievement of the human health objectives, the IJC recommends that:

- The Parties establish an accelerated and fixed period of time by which zero discharge of inadequately treated or untreated sewage into the Great Lakes will be effectively achieved and dedicate sufficient resources to accomplish the task.
- To reduce human exposure to untreated and inadequately treated sewage, the Parties increase funding directed to infrastructure improvement and provide support to communities to proactively and systematically improve the capacity to respond to extreme storm events, especially as related to combined sewer overflows, planning, zoning and adaptation.
- The Parties enhance reporting on progress toward achievement of the GLWQA's human health objectives by collecting and reporting on health data specific to the waters of the Great Lakes. The Parties should display binational health and environmental data on an ecosystem rather than domestic basis to facilitate public understanding and enable the analysis of affected populations and the distribution of impacts, such as beach closings.
- The Parties fix their fragmented approach to achieving the GLWQA human health objectives by developing mechanisms to enhance focus on objective achievement, increase coordination among jurisdictions and improve accountability, including more specific goals and timelines and a formalized approach to eliminate the silo effect across the Agreement annex committees.

3. CLIMATE CHANGE

Looming over all challenges to the Great Lakes is the unprecedented threat of climate change. Although its effects cannot be precisely forecast, climate change will continue to alter profoundly the characteristics of the ecosystem.

Phenomena observed in the Great Lakes over the last several decades have been linked to climate change, including reduced winter ice cover, altered stratification patterns, increased summer temperatures, and more frequent and intense storms. Climate change has emerged as a stressor to fish populations in large lakes, driven by processes including warmer temperatures throughout the water column, less ice cover, longer periods of stratification, and increased bottom hypoxia.

Biodiversity in general is being affected by climate change by shifting many species' distributions, and outpacing their adaptive capacities. As one example, the Commission has learned that climate change may be altering the traditional range of manoomin (wild rice) in the Great Lakes due to warming winters and changing water levels, affecting indigenous peoples' culture, health and well-being.

Although there is near unanimous scientific consensus that climate change is occurring, there continues to be uncertainty in establishing cause and effect linkages in the Great Lakes with climate change, and quantifying climate-induced effects is one of the grand challenges for Great Lakes research.

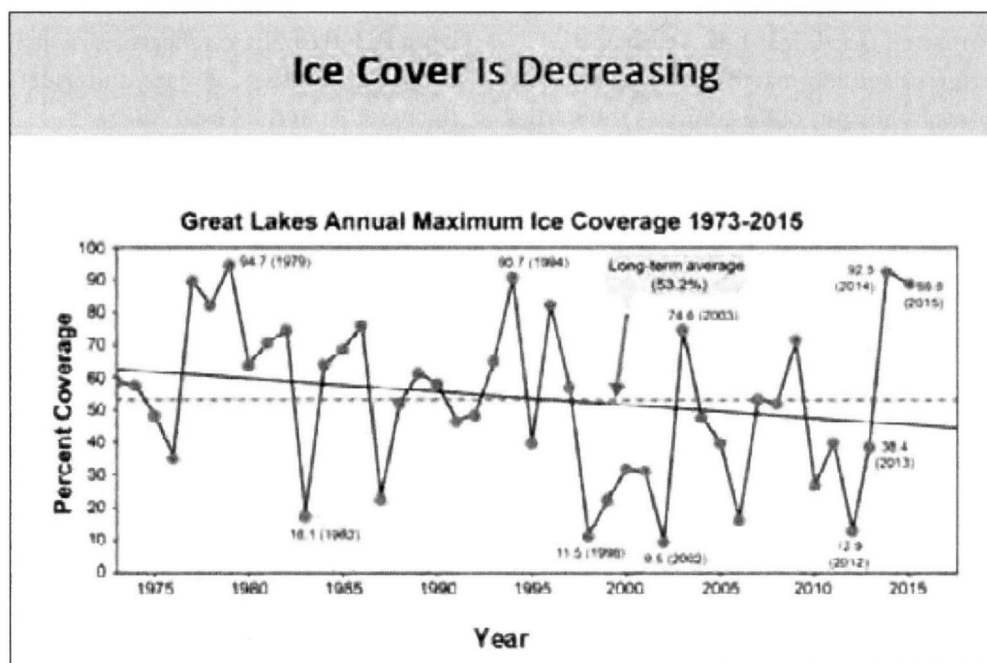


Figure 10: Ice coverage of the Great Lakes fluctuates from year to year but there is a downward trend over the past 40 years, possibly due to global climate change. (Source: SOGL 2017 Technical Report)

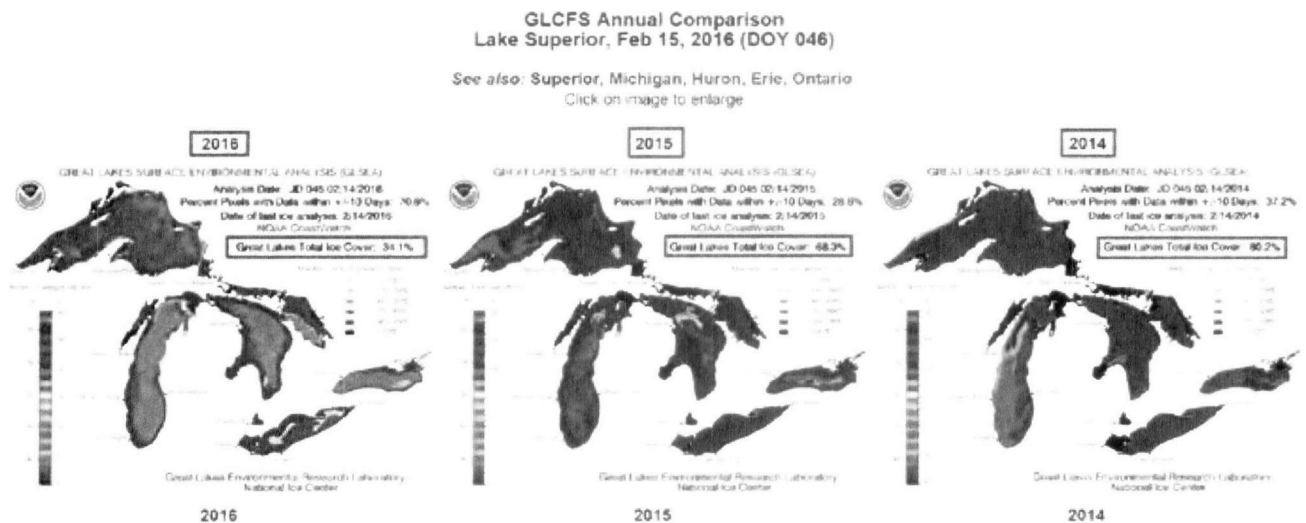
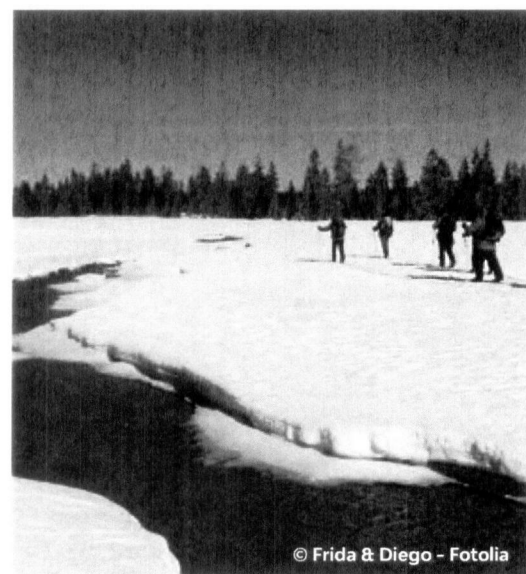


Figure 11: Comparison of Ice Cover 2014-2016. NOAA – Great Lakes Environmental Research Laboratory

Annex 9 of the GLWQA (Climate Change Impacts) commits the Parties “to identify, quantify, understand, and predict the climate change impacts on the quality of the Waters of the Great Lakes,” and to “sharing information that Great Lakes resource managers need to proactively address these impacts.” The annex also commits the Parties to coordinating actions where appropriate with water quantity management actions taken by or in conjunction with the IJC.

The Progress Report of the Parties identifies a significant number of domestic actions taken in the implementation of Annex 9. For example, Canada is developing Regional Climate Change models for the Great Lakes – St. Lawrence River system. Canadian federal agencies and organizations in Quebec are also conducting a coordinated evaluation of the impacts of climate change on the levels and flows of the St. Lawrence River from 1961-2100. In the United States, the National Oceanic and Atmospheric

Agency (NOAA) developed and released a basinwide Water Level Dashboard in 2014. The dashboard is an interface for visualizing projected, measured, and reconstructed surface water elevations on the earth’s largest lakes. The dashboard reflects relationships between hydrology, climate, and water level fluctuations in the Great Lakes.



Binationally, the Quarterly Climate Impacts and Outlook: Great Lakes Region, jointly prepared by NOAA and Environment and Climate Change Canada, provides a brief bulletin of the latest season's weather and water level conditions and impacts over the Great Lakes and provides an outlook for the upcoming quarter.

One of the most important actions the governments have taken to fulfill the Agreement's commitments on climate change was publication in 2015 of the *State of Climate Change Science in the Great Lakes Basin Report*. The report captures available science on impacts of climate change in the Great Lakes basin and inventories the climate change assessment methods applied in the region. It also includes a companion database with summaries of more than 250 recent climate change studies.

YOUR VOICE

"All the stakeholders need to acknowledge climate change and the need to adapt to it. Climate change is an environmental justice issue for citizens across the globe which will only increase over time."

Katie McKibben, Public Meeting on the Great Lakes, Toledo, Ohio, March 23, 2017

In implementing Annex 9, the Parties have satisfactorily addressed the science commitments related to climate change impacts, cooperated successfully on numerous measurement

and communications projects and met implementation timelines. However, greater emphasis must be placed on moving from a science focus (identification of climate impact) to an action-oriented focus (actions supporting climate adaptation and resiliency) based on an adaptive management approach.

To better understand the capacity of governments to confront the realities of climate change, a project completed under the auspices of the IJC's Great Lakes Water Quality Board looked at climate projections and their likely environmental impacts in the Great Lakes region. The project also examined the preparedness of governments for adaptation and resilience. Analysis from the project found that although most jurisdictions have a climate change policy or plan in place, mitigation is more common than climate change adaptation or resiliency planning. Newer plans are placing greater focus on adaptation measures and their implications for water quality. In most cases, adaptation planning remains a distinct activity, not fully integrated into broader government planning. Most adaptive actions are not adopted in light of climate change alone. It is therefore important to integrate climate change adaptation initiatives with other programs, such as resource management and sustainable development, coastal zone management, watershed management, and community development.

Municipalities in particular will face formidable water quality challenges resulting from climate change. With more frequent and intense storms, municipal combined sewer overflows can be expected to increase,

promoting eutrophication and hypoxia and exposing the public to pathogens through recreational contact or drinking water. The Water Quality Board found that stormwater management is not advancing with sufficient speed across all jurisdictions to address the changing climate. The importance of preventing combined sewer overflow discharges to the Great Lakes and their tributaries will only increase in the coming decades as the climate changes due to historic and ongoing greenhouse gas emissions. Governments need to invest in solutions that either increase storage within combined sewer systems or result in sewer separation.

The Water Quality Board project also showed the likelihood of increasing variability in lake levels and frequency of extreme precipitation events related to climate change. These events could lead

to loss of valued ecosystem services from coastal damage, pose challenges to the integrity of coastal water infrastructure and degrade wetlands and other nearshore habitats. The IJC, as part of its mandate on water levels and flows in the Great Lakes through the Boundary Waters Treaty, has a record of making recommendations to governments related to the wise management of shoreline and coastal land use as the principal component of mitigation strategies meant to alleviate the adverse consequences of constrained water level fluctuations. This includes consideration of land use planning and zoning as ways to safeguard shoreline and coastal regions and provide protection to fish and wildlife habitat from development that would negatively impact estuaries and wetlands.



Métis Nation of Ontario – www.metisnation.org

Climate Projections And Likely Environmental Impacts In the Great Lakes Region

Climate-related Projections in the Great Lakes Region	Likely Environmental Impacts
Warmer air temperatures (esp. warmer nights; warmer winters: even warmer water temperatures)	<ul style="list-style-type: none"> • Less ice cover; less stratification and oxygen distribution in the lakes • More lake evaporation year-round (trending to lower lake levels) up by 25 percent since 1980 • More favorable conditions for algae and bacteria • Loss of habitat and/or increased stress for cool and cold-water fish • Increased likelihood of heat waves and urban heat-island effects; heat-related illnesses • More warm weather pests, including invasive species • Stress on livestock and crops; reduced productivity • Loss of valued ecosystem services (flood buffers, water filtration, erosion stabilization, coastal habitat including nesting/nursery areas) from coastal erosion, damage to streamside habitat; loss of important populations • Challenges to coastal water infrastructure (drinking water intake and discharge disposal infrastructure not easily adaptable to high lake level variability) • Exposed contaminated areas from lower levels, dredging harbors to support shipping in low water years • Risks for coastal development during low water years and "hardening" shorelines
More precipitation and more extreme precipitation events	<ul style="list-style-type: none"> • Increased polluted runoff, especially from intense spring storms • Sediment and nutrient "flushes;" rapid increased loading in Great Lakes watersheds and the lakes themselves • Algal blooms oxygen depletion, dead zones, cyanobacteria • Loss of safe drinking water supplies • Degraded wetlands and coastal habitat

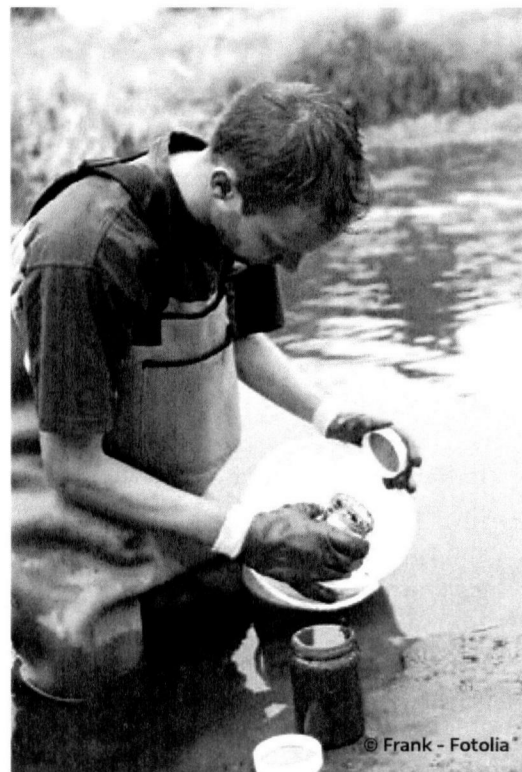
More extreme swings between periods of drought and drench	<ul style="list-style-type: none"> • Loss of valued ecosystem services (flood buffers, water filtration, erosion stabilization, coastal habitat including nesting/nursery areas) from coastal erosion, damage to streamside habitat; loss of important populations • Challenges to coastal water infrastructure (drinking water intake and discharge disposal infrastructure not easily adaptable to high lake level variability) • Exposed contaminated areas from lower levels, dredging harbors to support shipping in low water years • Risks for coastal development during low water years and "hardening" shorelines
Increasing variability in lake levels	<ul style="list-style-type: none"> • Loss of valued ecosystem services (flood buffers, water filtration, erosion stabilization, coastal habitat including nesting/nursery areas) from coastal erosion, damage to streamside habitat; loss of important populations. • Challenges to coastal water infrastructure (drinking water intake and discharge disposal infrastructure not easily adaptable to high lake level variability) • Exposed contaminated areas from lower levels, dredging harbors to support shipping in low water years • Risks for coastal development during low water years and "hardening" shorelines
Changes in vitality and distribution of cold-climate dependent species—both aquatic and terrestrial	<ul style="list-style-type: none"> • Changes in species range and relative abundance, especially for cool and cold-water fish • Likely range expansion for warm-weather invasive species , including diseases crop pests, expanded ranges for zebra and quagga mussels • Changes in terrestrial tree and plant species along coastal areas and Great Lakes tributaries that will likely alter wildlife species distribution
Nutrient and invasive species challenges exacerbated	<ul style="list-style-type: none"> • Polluted runoff from extreme storms enriches nutrient and bacteria loadings into nearshore waters • Zebra and quagga mussels filter nearshore waters, increasing light penetration • Sunlight penetration and warmer air temperatures warm the waters faster, deeper, and to higher temperatures; • Sunlight and warm water supports growth of algae and other phytoplankton • With plenty of nutrients, warm water and sunlight, algae growth "explodes" • Massive blooms die off and use up dissolved oxygen = dead zones
Changes in seasonal wind directional (vector) patterns	<ul style="list-style-type: none"> • Reduced exchange between waters in bays with low oxygen levels and open lake waters; potential increase in dead zones, especially Green Bay, western Lake Erie

Negative synergies from multiple effects	<ul style="list-style-type: none"> • Polluted runoff from extreme storms enriches nutrient and bacterial loadings into nearshore waters • Zebra and quagga mussels filter nearshore waters, increasing light penetration • Sunlight penetration and warmer air temperatures warm the waters faster, deeper, and to higher temperatures • Sunlight and warm water support growth of algae and other phytoplankton • With plenty of nutrients, warm water and sunlight, algae growth "explodes" • Massive blooms die off and use up dissolved oxygen = dead zones
--	---

IJC WQB Emerging Issues Work Group, Climate Change and Adaptation in the Great Lakes (2017)

The Water Quality Board report provides recommendations to the IJC calling for the Canadian and US governments to demonstrate global leadership by jointly developing a binational approach to climate change adaptation and resilience in the Great Lakes. The report also calls on governments to make investments in research, information sharing and knowledge management to carry out a vulnerability assessment, to engage stakeholders and rights holders, and to identify priorities for responsive actions in the Great Lakes region.

The Commission agrees that the unprecedented threat of climate change should compel both community and basinwide responses. All levels of government are implicated. All people can contribute.



Recommendations

To better consider and adapt to climate change impacts, the IJC recommends that:

- The Parties demonstrate global leadership by jointly developing, in cooperation with other government jurisdictions, including indigenous governments and organizations in the Great Lakes, a binational approach to climate change adaptation and resilience in the Great Lakes.
- The Parties invest in a binational vulnerability assessment, defining the risks posed by climate change and providing technical support for measures to adapt to climate change, to engage stakeholders and all orders of government, and to identify priorities for responsive actions in the Great Lakes region.
- The Parties recognize the impacts of climate change on water infrastructure and provide support to communities to proactively and systematically improve the capacity to respond to extreme storm events, especially as related to combined sewer overflows, planning, zoning and adaptation.

4. ENGAGEMENT

Under the GLWQA, the Parties agree to be guided by principles and approaches that include public engagement, which is defined as “incorporating Public opinion and advice, as appropriate and providing information and opportunities for the Public to participate in activities that contribute to the achievement of the objectives of this Agreement.”

In the preamble to the 2012 GLWQA, the Parties recognize that the involvement and participation of state and provincial governments, Tribal governments, First Nations, Métis, municipal governments, watershed management agencies, local public agencies, and the public are essential to achieve Agreement objectives. The public is defined in the GLWQA as “individuals and organizations such as public interest

groups, researchers and research institutions, and businesses and other nongovernmental entities.” As noted throughout this assessment report, the Parties have set an ambitious pace in undertaking implementation of many commitments under the GLWQA. In some cases, however, they have not incorporated robust public engagement into their activities.

YOUR VOICE

“Opportunities for industry to engage in scientific studies and development of resource management policy are essential; we would like to see more opportunities.”

Kathryn Buckner and Dale Phenicie, Council of Great Lakes Industries, letter via email, April 3, 2017

For example, LAMPs are meant to be a key mechanism for public engagement in the implementation of the GLWQA, but the Parties have been slow in providing public engagement opportunities and related activities for Annex 2, Lakewide Management. LAMP partnerships took more than three years to begin establishing their outreach and engagement work groups – after the existing committees were disbanded. For example, at the Sault Ste. Marie, Ontario public meeting, participants called the Lake Superior LAMP very beneficial but expressed frustration with the elimination of citizen forums. In the absence of these forums, the public had to start over again to get involved in development and implementation of the plan. Perhaps the most telling detail about public engagement was the near absence of comment on LAMPs in response to the Commission's request for public input on progress in Agreement implementation. Engagement in the LAMP process was not evident.

In contrast, there has been significant public engagement over the long history of the Area of Concern (AOC) program, with public advisory groups established and active for most of the AOC locations. However, there is no clear route for people engaged in AOC activities in a local area to provide input on the binational implementation and decision-making process for Annex 1, Areas of Concern. This GLWQA annex is the only one without an annex committee for implementation and therefore no extended subcommittee for public involvement in annex activities. Consequently, status reports and guidance prepared under this annex do not benefit from the input of engaged people or the broader public.

YOUR VOICE

"The IJC should stress to the governments that public involvement is important, and should be respected particularly in Areas of Concern."

Saul Simoliunas, Public Meeting on the Great Lakes, Detroit, Michigan, March 21, 2017



The PROP was intended, in part, to serve as a vehicle for public engagement. However, the 2016 report had limited value for public engagement because it was released to the public too close to the Great Lakes Public Forum to generate significant dialogue from Forum participants. The report was not mentioned at the Forum and was not marketed by the Parties to the general public, either through traditional or social media opportunities.

The Great Lakes Public Forum provided an opportunity for the Parties to encourage the public to learn about Great Lakes issues and to include people from all sectors of society in the GLWQA implementation process. Although the Forum was well attended and there were many informative presentations, this opportunity for public engagement was not fully utilized due to limited promotion, a venue that was difficult to access by public transit and a format that did not adequately encourage strong public interaction.

YOUR VOICE

"This Public Forum was not conducive to true public participation. We need to do better. We need to be having conversations in the communities across the Great Lakes, rather than just one or two each year."

Kristy Meyer, Ohio Environmental Council, IJC public comment session, Great Lakes Public Forum, Toronto, Ontario, October 5, 2016

A successful aspect of the Forum was live video streaming of the event through Detroit Public Television and TV Ontario. As outlined in the [Summary of Public Consultation Appendix](#), at least 8,600 people from 14 countries watched the Forum via the livestream and another 16,000 have watched portions of the meeting via videos provided on the Participate IJC website, the Detroit Public Television links, or via IJC Twitter and Facebook postings. These figures illustrate the keen interest the public has in learning more about the lakes and how they can contribute to their restoration and protection. They also reflect the quality of the presentations at the Forum itself, which conveyed the status of Great Lakes water quality in clearly understood graphics and language.

YOUR VOICE

"We express our sincere appreciation for the livestreaming...We hope the number of people who participated in the livestreaming justifies further similar efforts."

Andrew McCammon, Ontario Headwaters Institute, IJC public comment session, Great Lakes Public Forum, Toronto, Ontario, October 5, 2016



In every community where the IJC held public meetings about progress on the Agreement, residents expressed sincere appreciation that the Commission came to them. The Parties' Great Lakes Executive Committee and annex committee meetings can provide the same opportunity for public understanding,

appreciation and interaction if they are held throughout the Great Lakes basin at easily accessible locations. The meetings can be designed and promoted to provide opportunities for everyone to learn about Agreement programs, to interact with those working on Great Lakes issues, and to discover sources of information within their own communities. An enhanced presence on social media through Twitter and Facebook pages devoted specifically to the Parties' GLWQA programs as well as an interactive website would provide additional opportunities to update the public about initiatives and the many ways the public can become involved in restoring and protecting the lakes.

Community-based meetings and communication methods that encourage two-way conversations, rather than webinars, formal hearings and large conferences in which information is presented but little opportunity is provided for feedback or interaction, will more fully reflect the essential role the public plays in achieving the goals and objectives of the GLWQA. Greater inclusiveness would garner immediate results in terms of awareness of key Great Lakes issues, vocal support for programs to address them, and positive involvement in the GLWQA process.

YOUR VOICE

"All water pollution is connected to land use and management issues; policy and funding needs to focus on this. It's a process and getting public involvement is important."

Ronald Fadoir, Oakland County Water Resources Commission, Public Meeting on the Great Lakes, Detroit, Michigan, March 21, 2017



Another public engagement issue identified in the public meetings is the absence of a strong connection between GLWQA processes and many affected communities. The Parties should embrace the principle of fair treatment and meaningful involvement of all people regardless of race, color, national origin or income, with respect to public engagement and environmental policy setting for the Great Lakes. Past workshops and conferences, public meetings and outreach efforts carried out by the IJC and the Parties frequently have not been successful in engaging some minority and indigenous populations in the Great Lakes basin. Therefore, the water quality issues important to these groups may not be heard or understood. Through the IJC public consultation process, people confirmed that whether they live in urban or rural communities, they value the lakes according to how they can use and enjoy them. At a minimum, hearing new voices and meaningfully engaging people historically outside of traditional outreach efforts will enrich everyone with a better understanding of the breadth of issues facing the basin and its shared waters.

YOUR VOICE

"First Nation people have lived in peace and harmony with the Great Lakes basin since time immemorial...From the sleeping giants of Manitoulin Island to the Bays of Quinte and the Gulf of the St. Lawrence and all points in between, our creation stories, our songs, our ceremonies, our traditions and the voices of our ancestors echo ripples across the waters...We will continue to assert the need for respect, equity and empowerment through the voices of our ancestors."

Grand Chief Abram Benedict, Chiefs of Ontario,
IJC comment session at the Great Lakes Public
Forum, Toronto, Ontario, October 5, 2016

Recommendations

To better uphold the principle of engagement in GLWQA implementation, the IJC recommends that:

- The governments accelerate and deepen their approach to public engagement in Lakewide Action and Management Plans (LAMPs), including inbasin opportunities for participation and the use of social media and online participation mechanisms.
- The Parties include more opportunities for public engagement with diverse communities and more thoroughly engage Tribal, First Nations and Métis governments in GLWQA implementation, incorporating greater contributions from these groups in the triennial Progress Report of the Parties.



IJC (Milwaukee meeting)

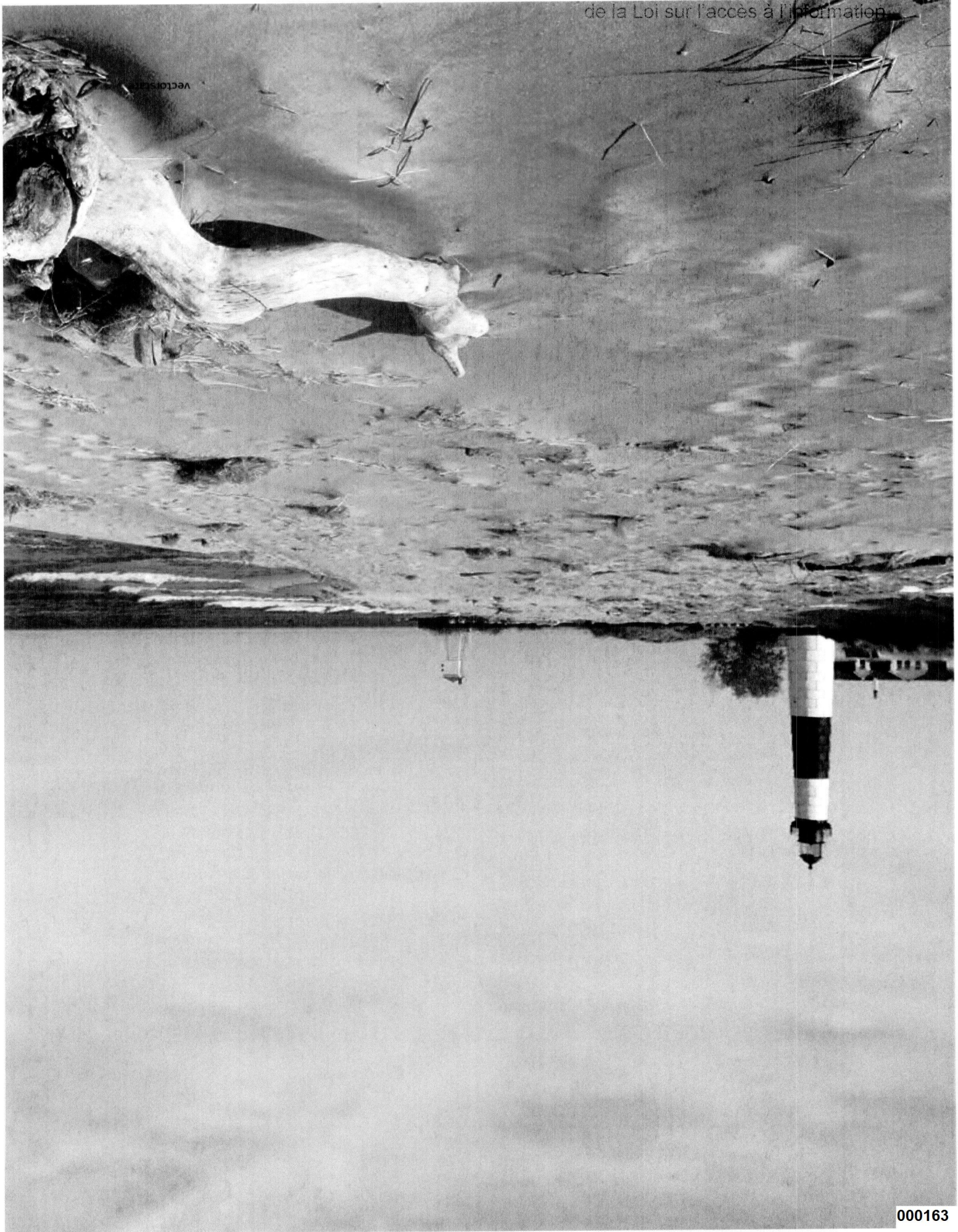
ENGAGING FIRST NATIONS, TRIBES AND MÉTIS

In the 2012 GLWQA, there is recognition in the preamble that the involvement and participation of Tribal governments, First Nations and Métis are essential to achieve its objectives. The GLWQA also directs the governments to work in cooperation and consultation with Tribes, First Nations and Métis on many aspects of Agreement implementation. However, the degree to which this is occurring is unclear. The Progress Report of the Parties does not provide details on engagement of indigenous governments or set out many of the actions that these governments undertake to value, restore and maintain the integrity of the Great Lakes. The number and volume of indigenous voices at forums like the Great Lakes Executive Committee are growing, but there is a distance to go before indigenous governments are full partners in the decision making about Great Lakes environmental stewardship. Particularly at the Great Lakes Public Forum, the IJC heard from Indigenous Peoples who want their sovereignty and rights to water respected. Indigenous Peoples' stewardship of the Great Lakes for cultural, ceremonial and subsistence practices should be protected and their traditional ecological knowledge valued in decision making. Tribal, First Nations and Métis peoples need to be engaged as rights holders by the governments with recognition and appreciation of their governance, identity, cultures, interests, knowledge and traditional practices.

First Nations in Ontario's treaty relationships make certain that decision-making processes related to use and care of the waters is a right maintained by the First Nations and not handed over with the making of Treaties...First Nations in Ontario have seen the need to declare, retain and assert our relationship with the waters to ensure that there is clean waters for the future generations

Excerpts from Water Declaration of the First Nations in Ontario, October 2008

The IJC has responsibilities under the GLWQA for analyzing and disseminating data and information obtained from Tribal governments, First Nations and Métis, among others and tendering scientific advice in return. The IJC also has responsibilities for consulting with and engaging the public. The IJC has valued the indigenous voices that have contributed to its call for public comment on progress under the GLWQA. Looking forward, the IJC will need to work to ensure that the voices of indigenous members of the public are heard and further consider how it can implement its responsibilities for engaging with indigenous governments on data and science, including through learning exchanges to better understand indigenous science and knowledge and how it can contribute to GLWQA implementation.



*There is no greater medicine than water –
it is foundational, our very beginnings, it
reminds us where we came from, our first
environment in the womb.*

-Elder, Chiefs of Ontario 2006

7. FINDINGS AND RECOMMENDATIONS

This first IJC assessment of progress under the 2012 GLWQA finds many accomplishments by the Parties and other governments. The GLWQA is once again a framework for meaningful binational effort to restore and protect the Great Lakes. However, in some instances the Parties have moved slowly in implementing actions. In other instances, the Parties have not yet fully embraced the GLWQA principles in their activities.



The most important of these principles, in the judgment of the IJC, is prevention. Preventing harm to Great Lakes water quality is not only a duty of good ecological stewardship but also sound public health and fiscal policy. The Parties should do more to anticipate problems and forestall them through action. A surge in dissolved reactive phosphorus in western Lake Erie, raw or poorly treated sewage flushing into the lakes, and contamination by flame retardants that replaced earlier toxins are examples of issues that the Parties could have averted, had there been forward looking policies at that time. To achieve GLWQA objectives, the Parties need to do a better job of preventing harm.

Two other GLWQA principles weigh heavily in the IJC's analysis. First, the Commission strongly supports the accountability envisioned by the GLWQA.

The Parties are to be commended for building accountability mechanisms into the 2012 GLWQA and for implementing them in the first triennial work cycle. However, accountability can be further improved as we move forward. Second, the Commission agrees with the GLWQA drafters that public engagement is vital. In preparing this report, the IJC consulted with the Great Lakes public across the basin and considered all of the input received in formulating these findings and recommendations. The Great Lakes public must be engaged more thoroughly by the governments if implementation of the GLWQA is to have maximum impact.

This chapter presents key findings from the IJC's first triennial assessment of progress, as well as recommendations for moving boldly into the next triennial cycle and beyond.

1. IMPLEMENTATION OF THE 2012 AGREEMENT

The Commission finds that the 2012 GLWQA galvanized new energies, activities and binational cooperation over a larger span of issues than were addressed under previous versions of the Agreement. The Parties are to be commended for authoring the new GLWQA, for giving it momentum and for harmonizing implementation activities amongst not just two countries, but eight states, two provinces and indigenous nations and hundreds of municipalities. In just three years the Parties have made remarkable progress formalizing mechanisms by which the new GLWQA can be implemented and

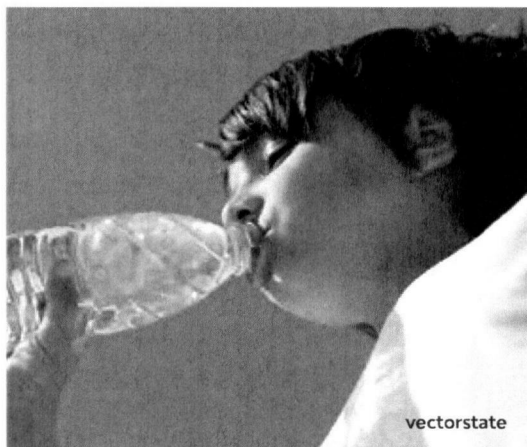
meeting deadlines for initial Agreement commitments. The Commission salutes the Parties for these achievements.

Recommendation

To continue and improve successes in GLWQA implementation, the IJC recommends that:

- The governments' financial investment in improving the water quality of the Great Lakes continue at current or higher levels.

2. PROTECTING HUMAN HEALTH



In the Preamble to the 2012 GLWQA, the Parties acknowledge “the close connection between quality of the Waters of the Great Lakes and the environment and human health, as well as the need to address the risks to human health posed by environmental degradation.” Progress in addressing human health is synonymous with progress in achieving the GLWQA objectives for drinking water, recreational water use and the consumption of fish and wildlife. Therefore achievement of these objectives is of paramount importance to the people of the Great Lakes basin.

However, the IJC finds that the Parties have not demonstrated sufficient progress toward achieving the human health objectives in their implementation of the GLWQA. Unfortunately, there are no annex or implementation committees devoted exclusively to these human health objectives. Reviews of the Progress Report of the Parties and the most recent State of the Great Lakes report show a lack of reporting specific to

programs in support of these objectives, and gaps exist in measuring and reporting key indicators to assess progress. Reporting indicators on a basinwide or even lake-by-lake scale also obscures the small minority of cases where source water or drinking water quality has been unacceptable and masks the distribution of impacts to beaches. The GLWQA objectives for drinking water and recreational water uses need to be met for everyone across the basin.

The Commission also finds that the continued input of inadequately treated and untreated sewage into the Great Lakes is unacceptable. Sewage overflows must be addressed to reduce the risk of human illness from Great Lakes waters. In this 21st century, after more than 100 years of water treatment, the public can no longer be asked to tolerate the dumping of raw sewage into the Great Lakes except under extremely rare conditions.

Recommendations

To improve progress toward achievement of the human health objectives, the IJC recommends that:

- The Parties establish an accelerated and fixed period of time by which zero discharge of inadequately treated or untreated sewage into the Great Lakes will be effectively achieved and dedicate sufficient resources to accomplish the task.
- To reduce human exposure to untreated and inadequately treated sewage, the Parties increase funding directed to infrastructure improvement and provide support to communities to proactively

and systematically improve their capacity to respond to extreme storm events, especially as related to combined sewer overflows, planning, zoning and adaptation.

- The Parties enhance reporting on progress toward achievement of the GLWQA's human health objectives by collecting and reporting health data specific to the waters of the Great Lakes. The Parties should display binational health and environmental data on an ecosystem rather than domestic basis to facilitate public understanding and enable the analysis of affected populations and the distribution of impacts, such as beach closings.
- The Parties fix their fragmented approach to achieving the GLWQA human health objectives by developing mechanisms to enhance focus on objective achievement, increase coordination among jurisdictions and improve accountability, including more specific goals and timelines and a formalized approach to eliminate the silo effect across the Agreement annex committees.



Specifically to improve progress toward the objective that the waters of the Great Lakes should be a source of safe, high-quality drinking water, the IJC recommends that:

- The Parties monitor and report on source water quality for drinking water, and the United States match the Ontario requirement for source water protection plans to protect drinking water supplies.
- The Parties address infrastructure needs to eliminate all longstanding boil water advisories and persistent drinking water violations for communities everywhere in the Great Lakes basin.

Specifically to improve progress toward the objective that the waters of the Great Lakes allow for human consumption of fish, the IJC recommends that:

- The Parties set a goal of reaching all populations vulnerable to health impacts from fish consumption with accessible and protective fish consumption advisories, and draw up a plan to do so. Populations include frequent consumers of Great Lakes fish such as subsistence anglers, many African Americans, indigenous communities, and some immigrant and other minority communities. It also includes those vulnerable to contaminants such as women of childbearing age and young children. In developing a plan to reach this goal, the Parties should collaborate more closely with representatives of these communities.

3. POLLUTANTS

Progress on the challenge to address pollutants in the Great Lakes has been disappointingly slow. In the first three years of GLWQA implementation, only eight chemicals of mutual concern have been identified. No strategies for the binational management of these chemicals have been completed. Additional resources are needed to help the Parties meet the timelines they set themselves for implementation and to protect Great Lakes water quality from chemicals of concern. The IJC finds that progress on chemicals of mutual concern has been insufficient relative to the threat that toxic pollutants pose to the health of humans, wildlife and aquatic organisms in the Great Lakes basin.

An approach that holds promise for preventing some toxic chemicals from entering the Great Lakes ecosystem assigns responsibility for minimizing or eliminating their presence in the environment to producers of pollutants and the products that contain them. The Canadian Council of Ministers of the Environment (CCME) established the Extended Producer Responsibility (EPR) Task Group to provide guidance on the development and implementation of a harmonized approach to EPR that could be applied across Canada. This effort resulted in the CCME Canada-wide Action Plan for Extended Producer Responsibility, an approach that should be considered for adoption by other governments. The Commission finds that opportunities exist for closer collaboration between Canada and the United States for joint identification and designation for products and materials for EPR action.

Recommendations

To improve progress toward achievement of the pollutants objective, the IJC recommends that:

- The Parties accelerate work on binational strategies for elimination or continual reduction of chemicals of mutual concern with clear timelines set and met for strategy development and implementation.
- The Parties develop strategies that have at their core the principle of zero discharge.
- The Parties adopt and extend policies and programs based on the principles of Extended Producer Responsibility (EPR) on a broad range of products, including flame retardants, to prevent introduction of toxic and non-toxic contaminants into the Great Lakes. The Parties should include status reports on EPR programs and policies in the triennial Progress Report of the Parties.



4. NUTRIENTS



The IJC finds that the water quality of western and central Lake Erie remains unacceptable. The Commission is investigating several nutrient-related topics and looks forward to providing its advice on those topics to governments in the current triennial cycle. In its 2014 report, *A Balanced Diet for Lake Erie*, the Commission included 16 recommendations for consideration by the Parties. The Commission reiterates several of those recommendations and calls for accountability in domestic action plans. The Commission acknowledges the progress that has been made by the Parties consistent with several of the recommendations, including setting phosphorus reduction targets for the western and central basins. In particular, the IJC commends the participative approach used by

the Parties for the development of these targets. However, the poor condition of Lake Erie warrants swifter action designed to achieve the targets, including domestic action plans with enforceable standards. The State of Ohio, under the United States Clean Water Act, should list the waters of the western basin of Lake Erie as impaired because of nutrient pollution. The State of Michigan has now done so. Ohio's listing would trigger the development of a tri-state phosphorus total maximum daily load (TMDL) involving Ohio, Michigan and Indiana, with U.S. Environmental Protection Agency oversight.

Recommendations

To achieve steep reductions in phosphorus loadings and harmful algal blooms and improve progress toward achievement of the nutrients objective, the IJC recommends that:

- Domestic action plans to achieve phosphorus loading reduction targets include details on timeline, who is responsible for actions, expected deliverables, outcomes and quantifiable performance metrics in order to assure accountability.
- The Parties further act on advice from the IJC's 2014 report on Lake Erie, most notably with respect to the need for enforceable standards governing the application of agricultural fertilizer and animal waste, along with better linkage between agricultural subsidies and farm operator use of conservation practices that are demonstrably effective at curbing phosphorus runoff.

- The State of Ohio, under the United States Clean Water Act, list the waters of the western basin of Lake Erie as impaired because of nutrient pollution. The State of Michigan has now done so.
- Periodic testing be required and enforceable standards for maintenance and replacement of septic systems be instituted in the United States and Canada.
- All levels of government provide adequate resources to implement better stormwater management systems in urban areas and accelerate the use of green infrastructure.

5. INVASIVE SPECIES

Prevention of new invasive species, both aquatic and terrestrial, received strengthened consideration in the 2012 GLWQA.

The Commission finds that there has been significant progress in preventing the introduction of aquatic invasive species to the Great Lakes. This includes Asian carp, where the level of effort and funds spent on Asian carp control are well justified by the fact that programs have curtailed their spread into the Great Lakes. However, continued vigilance is required to prevent new introductions and to sustain the fight against Asian carp invasion. Work is also required to control the spread of species that have already been introduced. The status of the State of the Great Lakes indicator for invasive species is poor and the trend deteriorating due to setbacks with the spread of several invasive species and the impact that this spread has had on the Great Lakes.

In particular, the IJC finds that invasive *Phragmites* is a serious threat to Great Lakes wetlands and immediate work is needed to control its spread throughout the watershed.

The Commission finds that binational efforts to combat invasive species lack the crucial elements of certainty and long-term planning

facilitated by uninterrupted program funding.

Recommendations

To improve progress toward achievement of the invasive species objective, the IJC recommends that:

- The Parties continue to devote significant resources to prevent Asian carp from invading the Great Lakes.
- The Parties continue to require ballast water exchange and flushing in addition to discharge treatment for seagoing vessels. Governments and industry should also dedicate sufficient research and testing to develop an effective binational approach to the regulation of ballast water discharge from "Lakers" within the next triennial reporting period.
- The Parties reach agreements on permitting the use of safe and effective control measures to reduce the spread of invasive species consistent across all jurisdictions within the next triennial reporting period.
- The Parties put in place long-term, sustainable funding mechanisms to support work on the fight against invasive species.

- Within the next triennial reporting period, the Parties invest significant resources to create an intensive, well-focused binational program for effective

basinwide practices and new tools that can control and eradicate the threat of *Phragmites* and prove useful in controlling other invasive plants.

6. ADDRESSING AREAS OF CONCERN

The Commission finds that the first work cycle of the 2012 GLWQA has been a time of great progress for Areas of Concern (AOCs). Of the 62 beneficial use impairments (BUIs) eliminated to date in the United States, half were eliminated between 2013 and 2016. In Canada, almost 20 percent of the 65 BUIs eliminated to date were removed in the triennial period covered by this report. Three US AOCs have been delisted in this work cycle, for a total of four delisted US AOCs. This compares to the total between 1987 and 2012 of one US AOC delisted, and three Canadian AOCs delisted and two AOCs in recovery. Continuing this momentum is important to achieve many of the GLWQA objectives. It will require continued, if not accelerated, funding and public engagement.

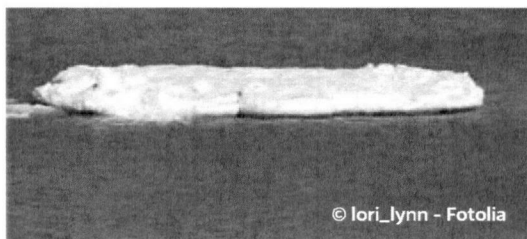


Recommendations

To address Areas of Concern, the IJC recommends that:

- The Parties set a goal of completing remedial actions for all Areas of Concern in the next 15 years, and maximize beneficial use impairment removals and AOC delisting during that time period.
- The Parties continue to advance implementation of remedial actions in all remaining Areas of Concern (AOCs) by maintaining recent Great Lakes Restoration Initiative investments in the United States and by accelerating cleanup at Canadian AOCs.
- The Parties enhance robust public engagement through the remedial action program by creating meaningful opportunities for binational dialogue between AOC stakeholders, and supporting public advisory councils as they transition to life after delisting in their AOC.

7. COPING WITH CLIMATE CHANGE



A changing climate has been influencing the Great Lakes for some time. Further climatic change is built into the future, thanks to inexorably rising carbon dioxide concentrations in the atmosphere and the consequences of these concentrations for temperature and precipitation regimes. A wide variety of water quality-related impacts will occur, ranging from more favorable conditions for the growth of algae and bacteria to increases in polluted runoff from intense storms. Such dramatic change poses significant challenges to governments at all levels and to communities across the basin.

The GLWQA charges the Parties to consider climate change impacts on the integrity of the waters of the Great Lakes and in Agreement implementation. It further challenges the Parties, in cooperation and consultation with state and provincial governments, Tribal Governments, First Nations, Métis, municipal governments, watershed management agencies, other local agencies and the public, to use their domestic programs to address climate change impacts to contribute to the achievement of the GLWQA's objectives.

Many Great Lakes communities as well as federal, state and provincial agencies are engaging in aspects of climate change adaptation planning and implementation. However, the Commission finds that there is need for a Great Lakes basinwide perspective, approach or strategy.

Recommendations

To better consider and adapt to climate change impacts, the IJC recommends that:

- The Parties demonstrate global leadership by jointly developing, in cooperation with other government jurisdictions, including indigenous governments and organizations in the Great Lakes, a binational approach to climate change adaptation and resilience in the Great Lakes.
- The Parties invest in a binational vulnerability assessment, defining the risks posed by climate change and providing technical support for measures to adapt to climate change, to engage stakeholders and all orders of government, and to identify priorities for responsive actions in the Great Lakes region.
- The Parties recognize the impacts of climate change on water infrastructure and provide support to communities to proactively and systematically improve the capacity to respond to extreme storm events, especially as related to combined sewer overflows, planning, zoning and adaptation.

8. ENGAGEMENT

Under the GLWQA, the Parties agreed to be guided by principles and approaches that include engagement, which is defined as “incorporating Public opinion and advice, as appropriate and providing information and opportunities for the Public to participate in activities that contribute to the achievement of the objectives of this Agreement.”

The Commission finds that the Parties have not fully incorporated robust public engagement into their activities. For example, the Parties are not showing sufficient urgency in confirming their approach to public engagement and related activities for Lakewide Management. Additionally, Lakewide Action and Management Plan (LAMP) partnerships took more than three years to begin establishing their outreach and engagement work groups – after disbanding the existing committees. Without robust engagement, connections do not always exist between GLWQA processes and many affected communities.

Looking to the future, the Commission finds that the IJC and the Parties should reach beyond the limits and audiences

typically recognized and should factor in consideration of environmental justice as a key objective. Reaching out to nontraditional populations and indigenous governments could provide lessons on how to address many of the problems facing the Great Lakes basin.

Recommendations

To better uphold the principle of engagement in GLWQA implementation, the IJC recommends that:

- The governments accelerate and deepen their approach to public engagement in Lakewide Action and Management Plans (LAMPs), including inbasin opportunities for participation and the use of social media and online engagement mechanisms.
- The Parties include more opportunities for public engagement with diverse communities and more thoroughly engage Tribal, First Nations and Métis governments in GLWQA implementation, incorporating greater contributions from these groups in the triennial Progress Report of the Parties (PROP).



9. ACCOUNTABILITY

Government accountability in GLWQA implementation is vital and reporting requirements are central to enacting this principle.

The IJC finds that the Parties have substantially improved accountability under the GLWQA by implementing a three-year reporting cycle, producing the Progress Report of the Parties, and improving the selection of indicators to support the assessment of progress toward achieving GLWQA objectives in the State of the Great Lakes report. As this has been the first reporting cycle, accountability mechanisms can be further improved in subsequent cycles.

Accountability can also be ensured through the acquisition of robust binational data that can be used to describe and quantify scientific indicators of Great Lakes water quality and track changes over time. Additional binational monitoring data are needed to make better-informed decisions about Great Lakes restoration and management strategies to restore and delist Areas of Concern and to ensure that impaired conditions do not return. Data are also needed to understand the linkages between storm events, agricultural and urban runoff, combined sewer overflows, and harmful algal blooms in order to develop effective prevention and mitigation strategies.

Recommendations

To further improve reporting and accountability, the IJC recommends that:

- The Parties set clear, time-bound targets for action and also longer-term aspirations for improvements in the status and trends of Great Lakes indicators as measured by science-based indicators.
- The Parties strengthen support for a comprehensive binational Great Lakes monitoring program to provide the essential information and understanding needed to quantify and interpret indicators, forecast change, prevent or mitigate impacts and restore and preserve the Great Lakes ecosystem.
- In future reporting cycles, the Parties coordinate the timing of the Progress Report of the Parties and the State of the Great Lakes report and release the reports sufficiently before the Great Lakes Public Forum to ensure informed discussion at the Forum.
- The next Progress Report of the Parties, expected in 2019, and those following include reporting on how the recommendations in this triennial assessment of progress are being addressed.

CONCLUSION



The 2012 GLWQA is a landmark in cooperative efforts to protect the Great Lakes. Its objectives, guiding principles and annexes have stimulated new scientific, programmatic and advocacy efforts on the part of the Parties and the broader Great Lakes community. These activities have renewed the reputation of the GLWQA as a globally significant framework for protecting and restoring shared freshwater resources.

A framework, however, is not enough to restore and protect the Great Lakes. Success requires much more of government: visionary goals based on strong science and a commitment to prevent degradation of the Great Lakes; long-term planning supported by adequate and consistent funding; clear and enforceable standards backed up by environmental monitoring and reporting; and a day-by-day commitment to preventing further harm. By now, it should be clear that prevention makes environmental, economic and common sense.

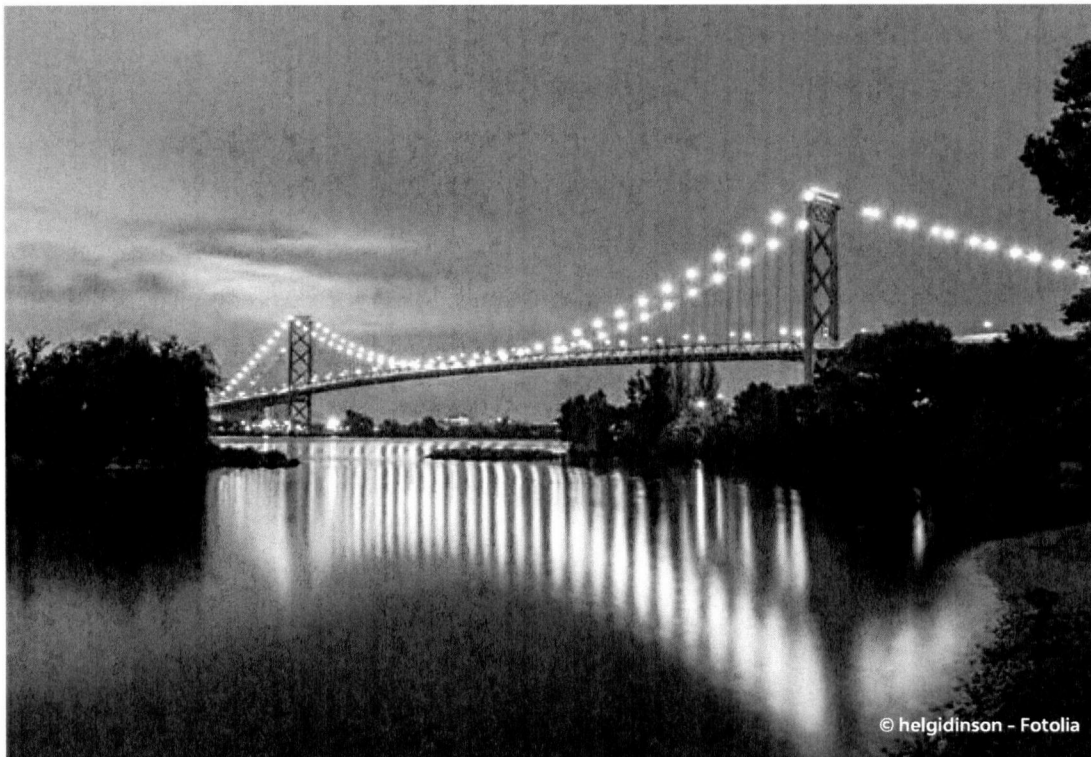
This report finds that the Parties have made remarkable progress on many seemingly intractable Great Lakes problems, from remediating many of the basin's worst contaminated sites, known as Areas of Concern, to slowing the introduction of aquatic invasive species to a near standstill. These are impressive accomplishments.

In other areas, this report finds that the Parties must improve performance if the Great Lakes are to be adequately protected. They must accelerate efforts and set goals and timelines to control chemicals of mutual concern and nutrient overloading; increase investment in infrastructure to prevent the discharge of inadequately treated sewage into waterways; protect and restore more wetlands to enhance ecological diversity and water quality; implement climate change adaptation strategies; and assure that waters are drinkable, swimmable and fishable for all populations in the basin. In addition to the recommendations to governments from the IJC, the input the Commission received from the public contains numerous recommendations and comments that should be reviewed and considered by the Parties and other governments, not all of which could be researched or commented upon in this report.

The Commission recognizes that without informed, active, organized public citizens, governments will fail to deliver on the GLWQA's promises. The late Dr. Jack Vallentyne, a Canadian co-chair of the IJC's Science Advisory Board and an enthusiastic educator of children, used to challenge his audiences with a friendly, "Have you been good to your ecosystem today?" Another leader, Joan Wolfe, founder of the West Michigan Environmental Action Council, frequently reminded people that, "Truly concerned citizens are the key to environmental protection."

The work done by Vallentyne, Wolfe and others continues to bear fruit. The 45 years that have elapsed since the signing of the initial GLWQA demonstrate that the people of the basin will defend these precious waters. In fact, the future of the Great Lakes depends on them.

The IJC offers this assessment of progress and recommendations to governments in the belief that an informed Great Lakes populace will insist that the Great Lakes Water Quality Agreement, and the effort to restore the Great Lakes themselves, continue to be a model to the world.



LIST OF ACRONYMS, FIGURES AND GLOSSARY

List of Figures

FIGURE 1.	Levels of PCBs have declined in herring gull eggs and fish	89
FIGURE 2.	USGS Science in the Great Lakes Mapper	96
FIGURE 3.	Habitat Restoration.....	98
FIGURE 4.	Imbalanced nutrient levels	101
FIGURE 5.	Comparison of Total Phosphorus (TP) Tributary Loads to Lake St. Clair and Lake Erie	105
FIGURE 6.	Distribution of Zebra and Quagga Mussels.....	110
FIGURE 7.	Phragmites Observations in the Great Lakes (1948–1961).....	116
FIGURE 8.	Phragmites Observations in the Great Lakes (1948–2015).....	116
FIGURE 9.	Generalized Groundwater - Surface Water Interactions (A) under natural conditions and (B) affected by pumping.....	121
FIGURE 10.	Ice cover is decreasing	143
FIGURE 11.	Comparison of Ice Cover	144

List of Acronyms

The following is a list of common acronyms used in the report:

4Rs	Right fertilizer, Right rate, Right time and Right place	GLEC	Great Lakes Executive Committee
AIS	Aquatic invasive species	GLRI	Great Lakes Restoration Initiative
AOC	Area of concern	GLWQA	Great Lakes Water Quality Agreement
BUI	Beneficial use impairment	HABs	Harmful algal blooms
CAFO	Concentrated animal feeding operation	HBCD	Hexabromocyclododecane
CCME	Canadian Council of Ministers of the Environment	HPAB	Health Professionals Advisory Board
CMC	Chemicals of mutual concern	IJC	International Joint Commission
CSMI	Cooperative Science and Monitoring Initiative	LAMP	Lakewide Action and Management Plan
CSO	Combined Sewer Overflow	LEEP	Lake Erie Ecosystem Priority
DFO	Fisheries and Oceans Canada	NOAA	National Oceanic and Atmospheric Administration
DDT	Dichlorodiphenyltrichloroethane	OMAFRA	Ontario Ministry of Agriculture, Food and Rural Affairs
DWQS	Drinking Water Quality Standards	OMOECC	Ontario Ministry of Environment and Climate Change
ECCC	Environment and Climate Change Canada	OMNRF	Ontario Ministry of Natural Resources and Forestry
E-DNA	Environmental DNA		
EPR	Extended Producer Responsibility		

PAH	Polycyclic aromatic hydrocarbons	SDWA	Safe Drinking Water Act
PBDEs	Polybrominated diphenyl ethers	SOGL	State of the Great Lakes
PCBS	Polychlorinated biphenyls	SOLEC	State of the Lakes Ecosystem Conference
PROP	Progress Report of the Parties	SWPP	Source Water Protection Plan
RAP	Remedial action plan	TAP	Triennial Assessment of Progress
RCC	Research Coordination Committee	USEPA	US Environmental Protection Agency
SAB	Great Lakes Science Advisory Board	USGS	United States Geological Survey
SPC	Science Priority Committee	WQB	Great Lakes Water Quality Board

Glossary

4RS NUTRIENT STEWARDSHIP PROGRAM – A nutrient stewardship program created by the agricultural industry, state agri-business associations, The Nature Conservancy, The Ohio State University, Michigan State University, state farm bureaus, state agencies and others. The program promotes best practices through the 4Rs, which refers to using the Right Source of Nutrients at the Right Rate and Right Time in the Right Place. Definition derived from the Fertilizer Institute.

ADAPTIVE MANAGEMENT – A planning process that can provide a structured, iterative approach for improving actions through long-term monitoring,

modeling and assessment. Through adaptive management, decisions can be reviewed, adjusted and revised as new information and knowledge becomes available or as conditions change.

ALGAE – Aquatic plants that survive through photosynthesis; they can range in size from microscopic organisms to large algae, like *Cladophora*.

ALGAL BLOOMS – An excessive and relatively rapid growth of algae on or near the surface of water. It can occur naturally as the result of a change in water temperature and current or as a result of an excess of nutrients in the water.

ANNEX COMMITTEE – A committee appointed by the Great Lakes Executive Committee to implement actions to achieve the general and specific goals of an annex of the Great Lakes Water Quality Agreement.

AQUATIC INVASIVE SPECIES (AIS) – As defined in the Great Lakes Water Quality Agreement, AIS refers to any non-indigenous species, including its seeds, eggs, spores, or other biological material capable of propagating that species, that threatens or may threaten the diversity or abundance of aquatic native species, or the ecological stability, and thus water quality, or water quality of infested waters, or commercial, recreational, or other activities dependent on such waters.

AREA OF CONCERN (AOC) – A location designated by the Parties under the Great Lakes Water Quality Agreement where environmental impairments resulting from local human activities prevent certain uses of the lakes. These impacts are termed beneficial use impairments, or BUIs.

ASIAN CARP – A type of fish native to Asia that has been introduced to the United States. Asian carp are regarded as highly invasive species in the US and Canada and capable of causing severe economic, ecological or human health harm. They include the following species: bighead carp (*Hypophthalmichthys nobilis*), black carp (*Mylopharyngodon piceus*), grass carp (*Ctenopharyngodon idella*) and silver carp (*Hypophthalmichthys molitrix*). Hybrids of silver and bighead carp also exist. Definition derived from the Michigan Department of Natural Resources.

BALLAST WATER – Liquid water carried or brought onboard and stored in tanks aboard a vessel to increase the draft, change the trim, regulate the stability or maintain safe stress loads on a ship.

BASIN – The region or area of which the surface waters and groundwater ultimately drain into a particular course or body of water.

BENEFICIAL USES – Uses and benefits of Great Lakes water quality and ecosystem resources, as identified in the Great Lakes Water Quality Agreement. They include fish and wildlife health and habitat, drinking water, and recreation.

BENEFICIAL USE IMPAIRMENT (BUI) – Under the Great Lakes Water Quality Agreement, a BUI is a reduction in the chemical, physical or biological integrity of the waters of the Great Lakes sufficient to cause any of the 14 identified impairments. These impairments include: restrictions on the human consumption of fish and wildlife; eutrophication or undesirable algae; restrictions on drinking water consumption; and beach closings.

BIOACCUMULATIVE – The accumulation of a substance, such as a toxic chemical, in the tissues of a living organism. Bioaccumulation takes place within an organism when the rate of intake of a substance is greater than the rate of excretion or metabolic transformation of that substance. Definition derived from The American Heritage Science Dictionary.

BLUE FLAG CERTIFICATION – An international certification for beach, marina or sustainable boating tourism operators created by the Foundation for Environmental Education. Certification criteria include standards for water quality, safety, environmental education and information and general environmental management criteria. Definition derived from the Foundation for Environmental Education.

BOUNDARY WATERS TREATY OF 1909 – The agreement between the United States and Canada that established principles and mechanisms for the resolution of disputes related to boundary waters shared by the two countries. The International Joint Commission was created as a result of this treaty.

CHEMICALS OF MUTUAL CONCERN – Under the Great Lakes Water Quality Agreement, the Parties agree to mutually determine those chemicals, coming from human-made sources that are potentially harmful to human health or the environment, and to take cooperative and coordinated measures to reduce the release of these chemicals.

CLADOPHORA – A genus of green algae found growing attached to rocks or timbers submerged in lakes and streams. *Cladophora* grows in the form of a tuft or ball with filaments that may range up to 13 cm (5 inches) in length.

CLIMATE CHANGE – A change of climate that is attributed directly or indirectly to human activity, that alters the composition of the global atmosphere,

and which is in addition to natural climate variability observed over comparable time periods.

CYANOTOXINS – Toxins which are produced and contained within cyanobacterial (blue-green algae) cells. Toxins are released during death or cellular rupture, including mechanical or chemical reactions. Cyanotoxins can be produced by a wide variety of cyanobacteria including *Microcystis*, *Anabaena* and *Planktothrix*. Definition derived from the USEPA.

DIOXIN – A group of toxic chemical compounds that share certain chemical structures and characteristics. Dioxins are formed in the production of some chlorinated organic compounds, including some herbicides. Dioxin compounds break down very slowly and persist for long periods of time in the environment. Dioxins are known to cause cancer, reproductive and developmental problems, damage the immune system, and interfere with hormones. Definition derived from the USEPA.

DECHLORANE PLUS – A polychlorinated chemical flame retardant used in electronic wiring and cables, automobiles, hard plastic connectors and plastic roofing materials. Dechlorane Plus has been detected in the air, fish, and sediment samples within the Great Lakes region. Definition derived from the Government of Canada.

DEEP GEOLOGICAL REPOSITORY

(DGR) – An underground storage cavern excavated within a stable geologic formation to store waste products from the production of energy using nuclear power. Facilities are built with the objective of achieving long-term isolation of radioactive material.

DOMESTIC ACTION PLAN

– Plans developed by the United States and Canada to combat the growing threat of toxic and nuisance algal development in Lake Erie. In 2012, through the Great Lakes Water Quality Agreement, the two governments agreed to establish binational phosphorus load reduction targets for Lake Erie by February 2016, and to develop domestic action plans that will outline strategies for meeting the new targets by 2018.

DRINKING WATER ADVISORY

– Public health protection messages issued by regulatory authorities to inform consumers about actions they should take to protect themselves from real or potential health risks related to their drinking water supply. Advisories are generally precautionary, and typically take three forms: Do not consume, Do not use and Boil water. Definition derived from Environment and Climate Change Canada.

ECOSYSTEM – A biological community of interacting organisms and their physical environment, including the transfer and circulation of matter and energy.

EDGE-OF-FIELD-MONITORING

– Voluntary water quality monitoring programs that measure the amount of nutrients and sediment in water runoff from a field, and compare the improvements

under different conservation systems.

Monitoring allows agricultural producers and scientists to quantify the impacts of conservation work on water quality. Definition derived from the United States Department of Agriculture.

ENVIRONMENT – Air, land or water; plant and animal life including humans; and the social, economic, cultural, physical, biological and other conditions that may act on an organism or community to influence its development or existence.

ENVIRONMENTAL JUSTICE

– environmental justice as the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Definition from the USEPA.

EUTROPHICATION – The process whereby water bodies become over-nourished either naturally by processes of maturation or artificially by excessive nutrient enrichment.

EXTENDED PRODUCER

RESPONSIBILITY (EPR) – A policy approach under which producers are given a significant responsibility – financial and/or physical – for the treatment or disposal of post-consumer products. Such practices provide incentives for manufacturers to prevent waste and may promote product design which is environmentally conscious, thereby achieving sustainable recycling and materials management goals. Definition derived from the Organisation for Economic Co-operation and Development.

FIRST NATION – A Canadian term used to describe an indigenous Native American community officially recognized as an administrative unit by the federal government or functioning as such without official status. Definition derived from the Government of Canada.

FISH CONSUMPTION ADVISORY – A recommendation to limit or avoid eating certain species of fish or shellfish caught from specific water bodies or types of water bodies (such as lakes, rivers or coastal waters) due to chemical contamination. Advisories may be issued for the general public or specific groups of people at risk, such as subsistence anglers, the elderly and pregnant or nursing women. Definition derived from the USEPA.

GENERAL OBJECTIVES – As defined in the Great Lakes Water Quality Agreement, General Objectives refer to the broad descriptions of water quality conditions consistent with the protection of the level of environmental quality the Parties seek to secure and which provide a basis for overall water management guidance. The Agreement identifies nine categories of General Objectives.

GREAT LAKES BINATIONAL TOXICS STRATEGY – The 1978 Great Lakes Water Quality Agreement committed Canada and the United States to virtually eliminate inputs of persistent toxic substances to the Great Lakes system in order to protect human health and to ensure the continued health and productivity of living aquatic resources and their human use. On April 7, 1997, Environment Canada and the United States Environmental Protection Agency signed the Great Lakes Binational

Toxics Strategy, which set forth a process to work in cooperation with their public and private partners toward the goal of virtual elimination of persistent toxic substances resulting from human activity from the Great Lakes basin.

GREAT LAKES VITAL SIGNS – A defined set of measures that were selected by the IJC based on their ability to inform the public about the status of the Great Lakes and whether the Great Lakes are getting better or worse. Relative to State of the Great Lakes reporting, Great Lakes vital signs are a subset of existing sub-indicators and proposed new sub-indicators.

GREAT LAKES WATER QUALITY AGREEMENT – The Agreement expresses the commitment of Canada and the United States to restore and maintain the chemical, physical and biological integrity of the Great Lakes Basin Ecosystem. The most recent protocol amending the 1978 Agreement was signed in 2012.

HARMFUL ALGAL BLOOMS (HABS) – HABs result from the proliferation of blue-green algae (including cyanobacteria) in environmentally stressed systems, where conditions favor opportunistic growth of one or more noxious species, displacing more benign ones. The blooms are considered harmful because excessive growth can harm ecosystems and produce poisons (or toxins) that can cause illness in humans, pets, livestock and wildlife.

HEXABROMOCYCLODODECANE (HBCD) – A brominated chemical flame retardant often used in furniture, automobile textiles, mattresses and polystyrene foam. Humans and animals may be exposed to HBCD from products and dust in the home, workplace and the environment. Definition derived from Natural Resources Defense Council.

HYDRAULIC FRACTURING – A chemical and mechanical method of drilling by forcing open fissures in subterranean rocks by introducing liquid at high pressure, especially to extract oil or gas. Also called “fracking.” Definition derived from the USEPA.

HYPOXIA – A condition of low or depleted oxygen in a water body, leading to regions where life cannot be sustained. Hypoxia occurs most often as a consequence of human-induced factors, especially nutrient pollution.

INDICATOR – As defined in State of the Great Lakes Technical Report, an indicator is a piece of evidence, (e.g. data or measures) that informs about current conditions. Watching the evidence over time gives an indication of trends. Doctors use specific measures such as blood pressure and temperature to assess one’s health. To assess large, complex ecosystems such as the Great Lakes, environmental indicators are a useful and accepted approach. Great Lakes indicators are used to:

- Assess conditions and track changes in the ecosystem;
- Understand existing and emerging issues;

- Guide programs and policies needed to prevent or address harmful environmental problems; and,
- Provide information to set priorities for research and program implementation.

Reporting on a suite of Great Lakes indicators produces a big picture perspective on the condition and trends of the complex ecosystem. Indicators have been used to report on Great Lakes ecosystem components since the first State of the Lakes Ecosystem Conference (SOLEC) in 1994.

INTERNATIONAL JOINT COMMISSION (IJC) – International independent binational agency formed in 1909 by the United States and Canada under the *Boundary Waters Treaty* to prevent and resolve boundary waters disputes between the two countries. The IJC makes decisions on applications for projects such as dams in boundary waters, issues Orders of Approval and regulates the operations of many of those projects. It also has a permanent reference under the Great Lakes Water Quality Agreement to help the two national governments restore and maintain the chemical, physical, and biological integrity of those waters.

LAKERS – Bulk carrier vessels or ships which carry cargo exclusively within the Great Lakes basin.

LAKEWIDE ACTION AND MANAGEMENT PLAN (LAMP) –

Under the Great Lakes Water Quality Agreement, a LAMP is an action plan for cooperatively restoring and protecting the ecosystem of a Great Lake. LAMPs are developed and implemented in consultation with US state governments and the province of Ontario and may include participation from local government agencies. LAMPs are in place for lakes Superior, Michigan, Erie and Ontario.

LAKE SUPERIOR ZERO DISCHARGE DEMONSTRATION PROGRAM –

A program designed to achieve zero release of certain designated persistent, bioaccumulative toxic substances in the Lake Superior basin.

MERCURY – A naturally-occurring chemical element found in rock in the crust of the earth, including in deposits of coal. Mercury becomes a problem for the environment when it is released from rock and ends up in the atmosphere and in water bodies. Human activities are responsible for most of the mercury pollution that is released into the environment, often by burning coal, oil, waste products and wood. Definition derived from the USEPA.

MÉTIS – A person of mixed Native American and Euro-American ancestry; in particular, one of a group of such people who in the 19th century constituted the Métis Nation in the areas around the Red and Saskatchewan rivers. Definition derived from the Government of Canada.

MICROCYSTIN – A naturally-occurring, potent liver toxin produced by the cyanobacteria *Microcystis*. Microcystin toxins are the most widespread cyanobacterial toxin and can bioaccumulate in common aquatic vertebrates and invertebrates such as fish, mussels and zooplankton. Definition derived from the USEPA.

MICROPLASTICS – Plastic particles that are smaller than 5-mm in diameter, such as preproduction plastic pellets and flakes, microfibers, breakdown materials from larger plastics and microbeads. Microbeads, the most well-known of these categories, are small plastic beads that are added as an abrasive to personal care products, including cosmetics, toothpastes, deodorants, shaving creams and sunscreens. Microplastics can be ingested by aquatic organisms, leading to a range of potential impacts including the transfer of plastics and associated toxins along the food web, potentially to humans.

NEARSHORE – As defined in IJC's 15th Biennial Report on Great Lakes Water Quality, the nearshore includes the relatively warm shallow areas near the shores, coastal wetlands that are dependent on lake levels, the connecting channels and virtually all of the major embayments of the system. This area is estimated to include approximately 90 percent of shallow Lake Erie, 25 percent of each of lakes Michigan, Huron, and Ontario, but only five percent of Lake Superior, which has deeper waters. The definition also describes the nearshore zone as including the land areas that are affected by the waves, wind, ice and temperature. In general, the nearshore zone extends about 16 kilometers (ten miles) into both land and water.

NITROGEN – A nutrient essential for plant and animal growth and nourishment which may exist in the forms of nitrate, nitrite, or ammonium. Excess nitrogen can cause the rapid growth of aquatic plants and algae.

NUTRIENT – A food or any nourishing substance assimilated by an organism and required for growth, repair, and normal metabolism. For example, phosphorus and nitrogen are nutrients for algae.

ONTARIO CLEAN WATER ACT – Ontario legislation to ensure access to safe drinking water. The act requires creation and execution of plans to protect the sources of municipal drinking water supplies. Local communities must evaluate the existing and potential threats to their water and set out and implement the actions necessary to reduce or eliminate significant threats. Definition derived from the Government of Ontario.

ONTARIO DRINKING WATER SURVEILLANCE PROGRAM (DWSP) – A program that monitors water quality at selected municipal drinking water systems for scientific and research purposes. DWSP is a voluntary partnership that complements the regulatory monitoring that must be done by the drinking water systems. DWSP monitors for inorganic, organic and radiological parameters. Definition derived from the Government of Ontario.

ONTARIO SAFE WATER ACT – An Ontario law that dictates owners and operators of drinking water systems that supply water to the public have responsibilities to ensure the water is safe

to drink. Definition derived from the Government of Ontario.

ONTARIO SOURCE WATER ASSESSMENT PROGRAM – A program that includes source protection plans which contain policies that either recommend or require that actions be taken to address activities identified as threats in the science-based assessment reports. Definition derived from the Government of Ontario.

OUTFALL – Any pipe or conduit used to carry water and either raw sewage or treated effluent to a final point of discharge into a body of water. Definition derived from the Organisation for Economic Co-operation and Development.

PARTICIPATE IJC – A website created by the IJC to fulfill its duties under the Boundary Waters Treaty to take into consideration views of all interested parties before the IJC makes decisions or recommendations.

PARTIES – The parties or signatories to the Great Lakes Water Quality Agreement. That is, the Governments of Canada and the United States.

PHOSPHORUS – A nutrient essential for plant and animal growth and nourishment, which exists in particulate or soluble reactive forms. The element used in a wide range of agricultural, industrial and domestic products. It is a key nutrient limiting the amount of phytoplankton and attached algae in the Great Lakes and most freshwater bodies.

PHRAGMITES – Genus of four species of perennial wetland grasses found in temperate and tropical regions. Specific reference to *Phragmites* in this document refers to *Phragmites australis*, a Eurasian genotype that can grow over 6 meters tall (19 feet) and can quickly crowd out native species by exuding a compound that kills the roots of neighboring plants and by blocking out light to other species.

POLYCHLORINATED BIPHENYLS (PCBS) – A group of human-made organic chemicals consisting of carbon, hydrogen and chlorine atoms. Because of their non-flammability, chemical stability, high boiling point and electrical insulating properties, PCBs were used in hundreds of industrial and commercial applications. PCBs were domestically manufactured from 1929 until manufacturing was banned in 1979. Definition derived from the USEPA.

POLYCYCLIC AROMATIC HYDROCARBONS (PAHS) – A class of chemicals that occur naturally in coal, crude oil, and gasoline. They also are produced when coal, oil, gas, wood, garbage, and tobacco are burned. PAHs can bind to, or form small particles in the air. Definition derived from the USEPA and US Centers for Disease Control.

PROGRESS REPORT OF THE PARTIES (PROP) – Under the Great Lakes Water Quality Agreement, the Parties agree to prepare a triennial progress report documenting actions taken domestically and binationally in support of the Agreement. The government production of the PROP and the IJC review of it is a key government accountability feature under the Agreement.

PUBLIC INFORMATION AND ENGAGEMENT – A proactive, coordinated process of informing the public throughout the course of a study and providing opportunities to interested individuals and organizations to make their views known and to review and comment on preliminary findings.

RADIONUCLIDES – An atom which has excess nuclear energy making it inherently unstable. Energy is typically released in the form of radiation. Radionuclides occur naturally, but they can also be produced artificially in nuclear reactors, cyclotrons, particle accelerators or radionuclide generators. They have a number of commercial and medical uses (i.e. radioisotopes).

REMEDIAL ACTION PLAN (RAP) – Under the Great Lakes Water Quality Agreement, plans designed to restore beneficial uses that have become impaired due to local conditions at Areas of Concern. Developed and implemented in cooperation with state and provincial governments, RAPs include: an identification of BUIs and causes; criteria for restoring beneficial uses, established in consultation with the local community; and remedial measures to be taken.

STATE OF GREAT LAKES REPORTING (SOGLR) – A process in which the governments of Canada and the United States regularly report on progress towards achieving the overall purpose of the Great Lakes Water Quality Agreement through reporting on ecosystem conditions and trends.

STORMWATER MANAGEMENT – Practices that help to minimize the impact of polluted agricultural and urban runoff flowing into lakes and streams, and reduce the impact of such runoff on water bodies.

TRIBES – A group or community of Indigenous peoples that the United States recognizes in a government-to-government relationship and exists politically in a “domestic dependent nation” status. Federally recognized Tribes possess certain inherent powers of self government and entitlement to certain federal benefits, services, and protections because of the special trust relationship. Definition derived from the Government of the United States of America.

US BEACHES ENVIRONMENTAL ASSESSMENT AND COASTAL HEALTH ACT (BEACH ACT) – The Beach Act addresses pathogens and pathogen indicators in coastal recreation waters.

US SAFE DRINKING WATER ACT – A US federal law that protects public drinking water supplies. Under the SDWA, the EPA sets standards for drinking water quality and with its partners and implements various technical and financial programs to ensure drinking water safety. Definition derived from the USEPA.

VULNERABILITY ASSESSMENT – Vulnerability is the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate change and variation to

which a system is exposed, its sensitivity to climate change, and its adaptive capacity. Adaptation actions are needed to eliminate or reduce the vulnerability of systems to the impacts of climate change. Vulnerability Assessments can support adaptation planning in several ways: identify areas most likely to be impacted by projected changes in climate; build an understanding of why these areas are vulnerable, including the interaction between climate change, non-climatic stressors, and cumulative impacts; assess the effectiveness of previous coping strategies in the context of historic and current changes in climate; and identify and target adaptation measures to systems with the greatest vulnerability. Definition derived from Ontario Centre for Climate Impacts and Adaptation Resources.

WETLAND – Areas of land where water saturates the soil at or near the surface all year or for varying periods of time. Wetlands support aquatic and terrestrial plants and animals. Examples of wetlands include swamps, marshes and meadows.

ZERO DISCHARGE – Concept which aims to eliminate toxic liquid, solid or gaseous substance releases into an aquatic, atmospheric or terrestrial environment.

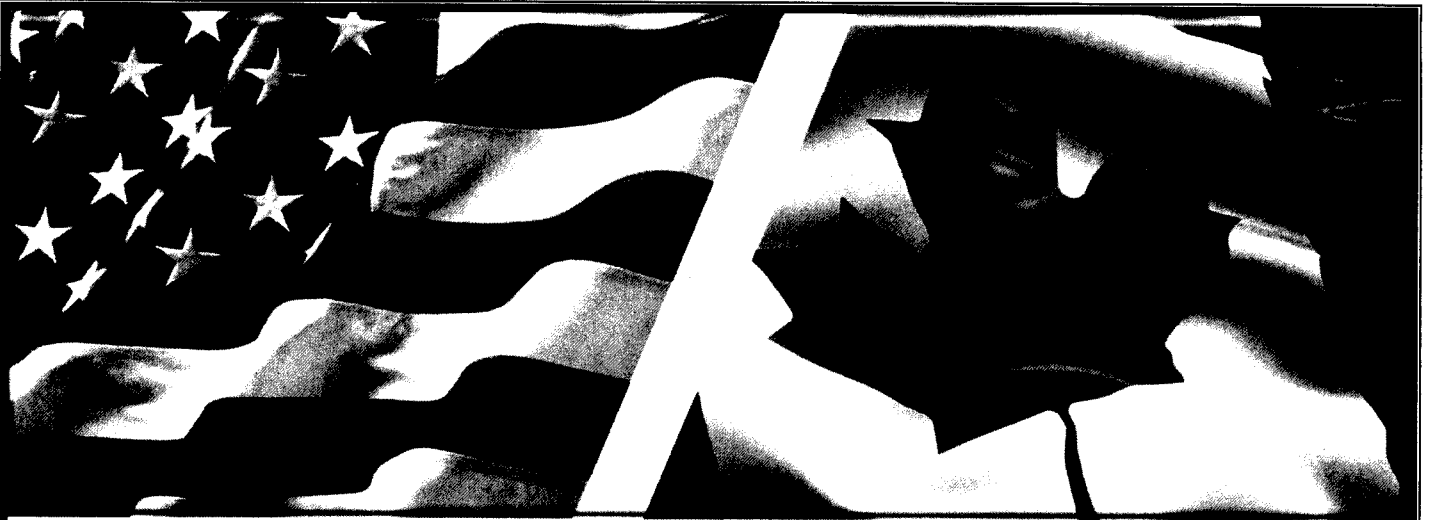
ZONING – Regulations and laws designed to implement developed land use plans used by municipalities. Zoning can be used to control development, improve safety and protect resources. Zoning can be divided into different categories of development which include residential, commercial, agricultural or industrial zones. Specific laws may regulate requirements for residential or commercial buildings, transportation and utilities.

~ FIRST TRIENNIAL ASSESSMENT OF PROGRESS ON~

GREAT LAKES WATER QUALITY

INTERNATIONAL JOINT COMMISSION
FINAL REPORT





2016 PROGRESS REPORT OF THE PARTIES

Pursuant to the Canada-United States
Great Lakes Water Quality Agreement



U.S. spelling is used throughout this report except when referring to Canadian titles. Units are provided in metric or U.S. customary units for activities occurring in Canada or the United States, respectively. Discussions of funding levels or costs in dollars is provided using Canadian dollars for activities occurring in Canada and U.S. dollars for activities occurring in the United States.

Cat. No.: En164-53/1-2016E-PDF

ISBN: 978-0-660-06365-2

Table of Contents

EXECUTIVE SUMMARY	1
INTRODUCTION	4
AREAS OF CONCERN ANNEX	12
LAKEWIDE MANAGEMENT ANNEX	23
CHEMICALS OF MUTUAL CONCERN ANNEX	28
NUTRIENTS ANNEX.....	33
DISCHARGES FROM VESSELS ANNEX	49
AQUATIC INVASIVE SPECIES ANNEX	56
HABITAT AND SPECIES ANNEX	68
GROUNDWATER ANNEX	76
CLIMATE CHANGE IMPACTS ANNEX	81
SCIENCE ANNEX.....	89
SUMMARY AND CONCLUDING REMARKS.....	99

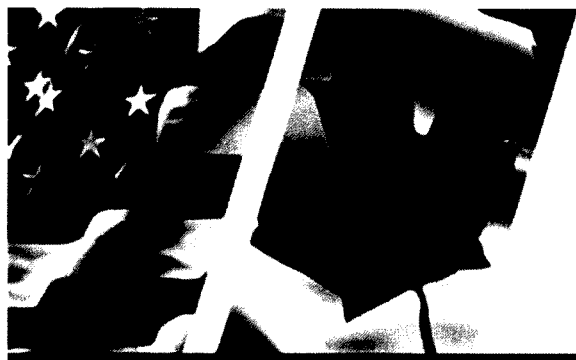
Figures

Figure 1 – The History of the Great Lakes Water Quality Agreement.	6
Figure 2 – Great Lakes Water Quality Agreement Implementation at a Glance (2013-2016).	9
Figure 3 – Canadian and U.S. Great Lakes Areas of Concern.	13
Figure 4 – Examples of Habitat, Wastewater and Non-point Source Domestic Actions in Canadian AOCs. .	17
Figure 5 – Components of the Great Lakes Nearshore Framework.	25
Figure 6 – 2015 LAMP Annual Reports.	27
Figure 7 – Excess Phosphorus Loadings Threaten Great Lakes Water Quality and Ecosystem Health.	33
Figure 8 – Major Tributaries to Lake Erie and the Priority Watersheds for Nearshore Blooms. Tributary Size Indicates Magnitude of Phosphorus Loading to the Lake in 2008.	36
Figure 9 – Total Phosphorus Loads to Lake Erie by Source Type, 1967 - 2013.	38
Figure 10 – Joint United States and Canada Ballast Water Exchange Management Success in Preventing Invaders.	59
Figure 11 - Battling Asian Carp Together.	62
Figure 12 – Lakewide Habitat and Species Protection and Restoration Conservation Strategies.	69
Figure 13 – Examples of How Biodiversity Conservation Strategies are Being Used in Each Lake Basin to Inform and Implement Priority Conservation Actions.	70
Figure 14 – Locations of Monitoring Wells in the Great Lakes Basin with Publicly Available Water Quality Analyses.	78
Figure 15 – Great Lakes Climate Quarterly March 2016 Newsletter.	82
Figure 16 – Cover Page of the State of Climate Change Science in the Great Lakes Basin: A Focus on Climatological, Hydrologic and Ecological Effects.	83
Figure 17 – Indicators and Sub-Indicators for Assessing the State of the Great Lakes.	91
Figure 18 – State of the Great Lakes Report Timeline.	92
Figure 19 – Research Efforts on the Great Lakes.	93
Figure 20 – The Cooperative Science and Monitoring Initiative Rotational Cycle.	94
Figure 21 – United States Environmental Protection Agency's Great Lakes National Coastal Condition Assessment.	96

Tables

Table 1 – Status of Beneficial Use Impairments in the Canadian Great Lakes Areas of Concern.	18
Table 2 – Status of Actions in Canadian Great Lakes Areas of Concern.	19
Table 3 – Status of Beneficial Use Impairments in the U.S. Great Lakes Areas of Concern.	21
Table 4 – Status of Actions in U.S. Great Lakes Areas of Concern.	22

2016



EXECUTIVE SUMMARY

PROGRESS REPORT OF THE PARTIES

The Great Lakes are an invaluable resource. Not only do they hold roughly 20% of the world's fresh water supply, but they also constitute an ecological, aesthetic, economic, and recreational treasure upon which tens of millions of people (and countless other species) rely. The Governments of Canada and the United States have long recognized this, and formally signified this recognition in 1972 by signing the Great Lakes Water Quality Agreement ("Agreement" or "GLWQA").

In 2012, Canada and the United States significantly revised the GLWQA to strengthen and modernize the Agreement and included a new requirement for a Progress Report of the Parties (Report) to be issued once every three years "to document actions relating to this Agreement". This reporting requirement strengthens the accountability provisions of the Agreement, with the Report to be provided to the public and the International Joint Commission. Consistent with that requirement, the Parties are pleased to release this first Progress Report of the Parties, documenting the actions taken since the 2012 Agreement took effect in February of 2013.

"Operationalizing" the Agreement

Significant effort was required to develop and put into place the organizational structure and processes required to implement the Agreement. The Great Lakes Executive Committee – the binational committee tasked with supporting the implementation of the Agreement – was called to order, Annex Subcommittees and their task teams were staffed and organized, activities were prioritized, policies debated, and responsibilities assigned. Further, given the cooperative approach that underpins the Agreement, these structural activities were not limited to the Parties; they required the very active participation of the Parties' many partners, including states and provinces and Indigenous peoples on both sides of the border, and others. Ultimately, as of the writing of this Report, the Parties can state that much of the necessary administrative and organizational work is finished. Consequently, in the upcoming triennial cycle of 2017-2019, the Parties will be able to concentrate even more heavily on the implementation of substantive restoration and protection activities.

Key Actions Completed Under the Agreement

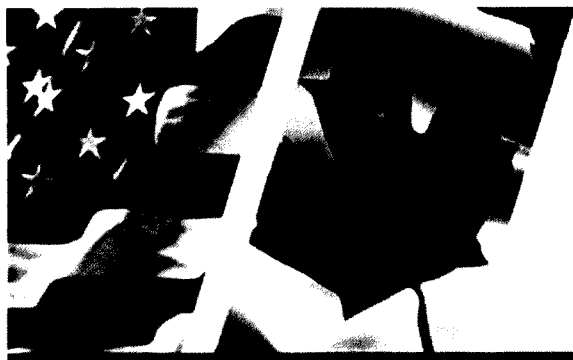
Notwithstanding the efforts needed to "operationalize" the 2012 Agreement, during the past three years the Parties, together with the many partners who also play important roles in restoring and protecting the Great Lakes, were able to undertake and complete a host of actions in furtherance of the Agreement's purpose: restoring and maintaining the chemical, physical, and biological integrity of the waters of the Great Lakes. It is impossible to describe in this report the full range of actions implemented across the various jurisdictions which share responsibility for the Great Lakes; however, this report provides an overview of activities undertaken since the Agreement took effect. Some noteworthy accomplishments by the Parties – with exceptional help from state and provincial governments, tribal governments, First Nations, Métis, municipal governments, watershed management agencies, local public agencies, industry, environmental groups, academia and the public – include:

- The Parties established the Great Lakes Executive Committee, comprised of members and observers representing some of the region's most forward-thinking leaders, to ensure that Agreement implementation is coordinated and effective.
- The Parties effectively implemented a new system, under Agreement Article 6(c), for providing notification to the Great Lakes Executive Committee members and observers, as well as other interested parties, of planned activities that could lead to a pollution incident or that could have a significant cumulative impact on the waters of the Great Lakes.
- The United States "delisted" the Presque Isle (Pennsylvania), Deer Lake (Michigan) and White Lake (Michigan) Areas of Concern (AOC), signifying that remedial actions were completed and elimination of environmental impairments was confirmed. In addition, all necessary remedial actions were completed at other AOCs in the United States: Sheboygan Harbor (Wisconsin), Waukegan Harbor (Wisconsin), Ashtabula River (Ohio), and St. Clair River (Michigan), and River Raisin (Michigan, expected to be completed in November).
- Canada completed all required actions to restore the Nipigon Area of Concern and began remediation of the Randle Reef contaminated sediment site in the Hamilton Harbour Area of Concern, the largest sediment remediation project ever undertaken in Canada.
- The Parties developed a "Nearshore Framework", which provides a mechanism for undertaking a systematic, integrated and collective approach for assessing nearshore health and identifying and communicating cumulative impacts and stresses.
- The Parties developed a Lakewide Action and Management Plan for Lake Superior.
- The Parties designated eight chemicals as the first *Chemicals of Mutual Concern* under the Agreement.
- The Parties set phosphorus load reduction targets for the western and central basin of Lake Erie after extensive analysis of phosphorous sources and loads and have begun to develop Domestic Action Plans to achieve the 40% reduction.
- The Parties significantly reduced the risk of the introduction of Aquatic Invasive Species (AIS) to the Great Lakes via ballast water discharges from saltwater vessels. As a consequence of compatible ballast water exchange regulations between Canada and the United States and stringent binational enforcement, no new invasive species attributable to the ballast water of these ships have been reported in the Great Lakes since 2006. In addition, the Parties continue to prevent and address other discharges from vessels that potentially may impact the waters of the Great Lakes.
- The Parties undertook a host of invasive species control and prevention measures, including the development and implementation of an AIS early detection and rapid response initiative, and no new non-native species are known to have become established in the Great Lakes during the last three years.

- The Parties oversaw the development and implementation of lakewide habitat and species protection and restoration conservation strategies (*i.e.*, Biodiversity Conservation Strategies) for all five of the Great Lakes.
- The Parties led the development of a report entitled *Groundwater Science Relevant to the Great Lakes Water Quality Agreement: A Status Report*, which summarizes the relevant and available Great Lakes groundwater science and advances understanding of the effects of groundwater on Great Lakes water quality.
- The Parties led the development of a report entitled *State of Climate Change Science in the Great Lakes Basin: A Focus on Climatological, Hydrologic and Ecological Effects* which synthesizes the state of climate change impacts in the Great Lakes basin and identifies key knowledge gaps.
- The Parties updated and revised the suite of ecosystem indicators used to evaluate and report on the state of the Great Lakes to better align the indicators with the General Objectives of the 2012 GLWQA.

These highlighted actions, while significant, represent only the first concrete steps in restoring and protecting the waters of the Great Lakes under the 2012 Agreement. More importantly, they reflect the vigor with which the Parties intend to implement the Agreement over the next three years.

2016



INTRODUCTION

PROGRESS REPORT OF THE PARTIES

The Great Lakes contain a significant portion of the world's freshwater, containing one fifth of global fresh surface water. The Great Lakes are immensely important to both Canada and the United States, environmentally, economically, and socially.

The Canada-United States Great Lakes Water Quality Agreement ("GLWQA" or "Agreement") was first signed in 1972. Over the course of its more than forty-year history (shown in Figure 1), the Agreement has served as an important mechanism for coordination of actions by Canada and the United States, working in cooperation with other levels of government, non-governmental organizations, industry, Indigenous peoples, and the public to address threats to Great Lakes water quality and ecosystem health.

Over the last 45 years, Canada and the United States have taken action to address many threats to Great Lakes water quality and ecosystem health. In many locations, and in many ways, water quality has greatly improved. Most notably, releases of many persistent toxic substances (for example, mercury, PCBs, dioxins and furans, as well as banned pesticides such as DDT) in the Great Lakes have been reduced by more than 90%. As a result, the frequency of deformities in colonial nesting birds, commonly seen in the 1970s, has now been significantly reduced. Sentinel species such as the Bald Eagle, once extirpated from the Great Lakes, now thrive along Great Lakes shorelines. The rapid recovery of a "dead" Lake Erie is another globally-known success story. In the decades leading up to the 1970s, loadings of nutrients, particularly phosphorus, caused significant algal blooms and degraded Lake Erie. Stirred by public concern, governments responded to reduce loadings from municipal sewage treatment plants and other anthropogenic sources, resulting in measurable reductions in phosphorus inputs and a steep reduction in algal blooms. These controls of phosphorus inputs to the lakes represented an unprecedented success in producing environmental results through international cooperation.

Despite these past successes, the lakes continue to face threats posed by nutrient discharges, releases of toxic substances, invasive species, loss of wetland and other habitat, climate change and other factors. Continued action is required to address these existing threats, as well as to anticipate and prevent new threats to water quality and ecosystem health.

In 2012, the Parties amended and strengthened the GLWQA. The 2012 Agreement updates approaches to science and management and reaffirms existing commitments to: restore degraded Areas of Concern; address the threats posed by excess nutrients, chemicals of mutual concern, and discharges from vessels; and undertake vital scientific coordination and research. In addition, the new Agreement includes new commitments to address other significant challenges to Great Lakes water quality, including threats from aquatic invasive species and climate change, as well as the loss of habitat and species.

One of the new commitments made by the two Governments in the Agreement is to enhance accountability and reporting by, for the first time, requiring the production of a Progress Report of the Parties. In accordance with the GLWQA, Canada and the United States have prepared this Progress Report of the Parties, in consultation with representatives of state and provincial governments, tribal governments, First Nations, Métis, municipal governments, watershed management agencies, and other local public agencies. The Progress Report of the Parties contains an overview of binational and domestic activities that have contributed to the achievement of GLWQA objectives.

This document represents the first Progress Report of the Parties prepared under the 2012 Great Lakes Water Quality Agreement. Subsequent Progress Reports of the Parties will be issued every three years.

Binational activities are coordinated through the Great Lakes Executive Committee. Following signing of the GLWQA in September of 2012, a significant amount of effort was devoted to the establishment of management processes and structures necessary to drive the Agreement's implementation. Annex Subcommittees and Task Teams have been created to engage a large and diverse group of organizations, institutions and experts in carrying out the necessary activities to support undertaking the commitments laid out in the Agreement.

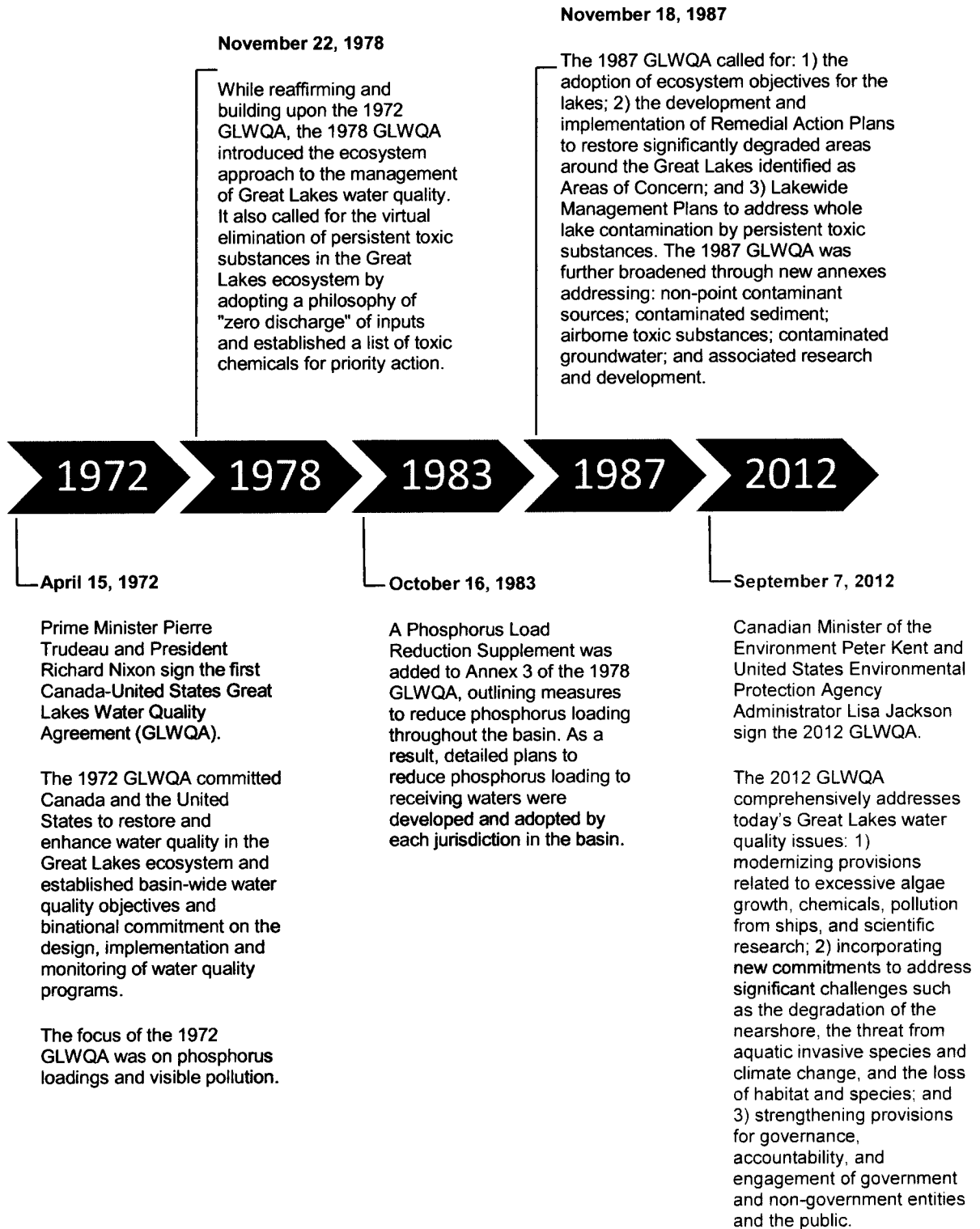
Within Canada, the principal mechanism for coordination of Great Lakes activities is the Canada-Ontario Agreement on Great Lakes Water Quality and Ecosystem Health, 2014 (COA), which entered into force in December 2014. A series of Canada-Ontario Agreements date back over forty years and have provided a framework for cooperation and coordination of actions between Ontario and Canada to restore, protect and conserve Great Lakes water quality and ecosystem health.

Within the United States the principal mechanism for coordination and implementation of Great Lakes activities is the Great Lakes Restoration Initiative (GLRI). In 2009, the Administration proposed and Congress appropriated \$475,000,000 for Great Lakes restoration and protection work and the formation of an Interagency Task Force chaired by the United States Environmental Protection Agency. The Interagency Task Force consists of eleven federal departments or agencies that work closely together to: 1) identify Great Lakes restoration and protection priorities; 2) make project funding decisions; and 3) keep track of and report on project results.

For those wishing additional information on Great Lakes activities, including how to get involved in helping to restore and protect the Great Lakes, additional information is available at the following websites: www.ec.gc.ca/greatlakes; www.epa.gov/greatlakes; www.glri.us/; and www.binational.net.

This Report follows the structure of the 2012 Agreement. The beginning of the report addresses progress of the Parties in relation to the thirteen Articles of the Agreement, which set forth the overall goals and "mechanics" of the Agreement. The remaining sections address progress of the Parties in relation to each of the ten Annexes of the Agreement, each of which addresses a particular threat (e.g., invasive species, climate change) or provides specific direction on the implementation of the Agreement (e.g., Lakewide Action and Management Plans, Science).

Figure 1 – The History of the Great Lakes Water Quality Agreement.



2012 Great Lakes Water Quality Agreement Articles

The GLWQA contains 13 Articles. Article 2 identifies the purpose of the Agreement, as well as principles and approaches to be used in the Agreement's implementation. Articles 3, 5, and 6 contain specific commitments to be delivered by the Parties.

Article 2: Purpose, Principles and Approaches

- The overall Purpose of the Agreement has remained virtually unchanged since 1972, a testament to the timeless statement by both countries and their partners to “restore and maintain the chemical, physical, and biological integrity of the Waters of the Great Lakes.”
- Many of Article 2's “Principles and Approaches” are new with the 2012 Agreement. Others represent a more direct expression of what had previously been implicit. Like the Purpose, however, they help drive the planning and implementation of the remaining Articles and Annexes. For example, Article 2(4)(j) commits the Parties to anticipate and prevent “pollution and other threats” to achieving the Agreement's Purpose. This places an onus on the Parties to “think ahead” and “act ahead,” such as with efforts to keep invasive species like Asian carp, from entering the Great Lakes in the first place. Other specific examples of how the Parties are achieving Article 2's mandates are provided throughout this Report.
- “Public engagement” is one of these new principles in the 2012 GLWQA. The Parties have committed to incorporating public opinion and advice, as appropriate, and providing information and opportunities for the public to participate in activities that contribute to the achievement of the objectives of the 2012 Agreement. Efforts to significantly enhance transparency and accountability have been central to planning and implementation of the 2012 GLWQA and include a revitalized website (binational.net) to document the implementation of the Agreement, issue-specific webinars and other participatory opportunities, and open meetings of the Great Lakes Executive Committee. A list of binational engagement opportunities, past and present, is maintained at binational.net (<https://binational.net/engagement-participation/>). Specific examples of the Parties' engagement, outreach and education efforts are highlighted throughout this Report.

Article 3: Progress in achieving General Objectives, Lake Ecosystem Objectives and Substance Objectives

- The 2012 GLWQA commits the United States and Canada to maintaining a set of comprehensive, science-based ecosystem indicators in order to assess and report to the public on the state of the Great Lakes. Binational reporting on the state of the Great Lakes has been ongoing since 1994. Over the past three years the Parties have updated and revised the suite of ecosystem indicators used to report on the state of the Great Lakes to align the indicators to the General Objectives of the 2012 GLWQA. This significant change to the way in which the Parties assess and report on the state of the Great Lakes allows the suite of ecosystem indicators to be used to assess whether progress is being made in relation to accomplishing the objectives set out by the Governments of the United States and Canada in the 2012 GLWQA. Information on the state of

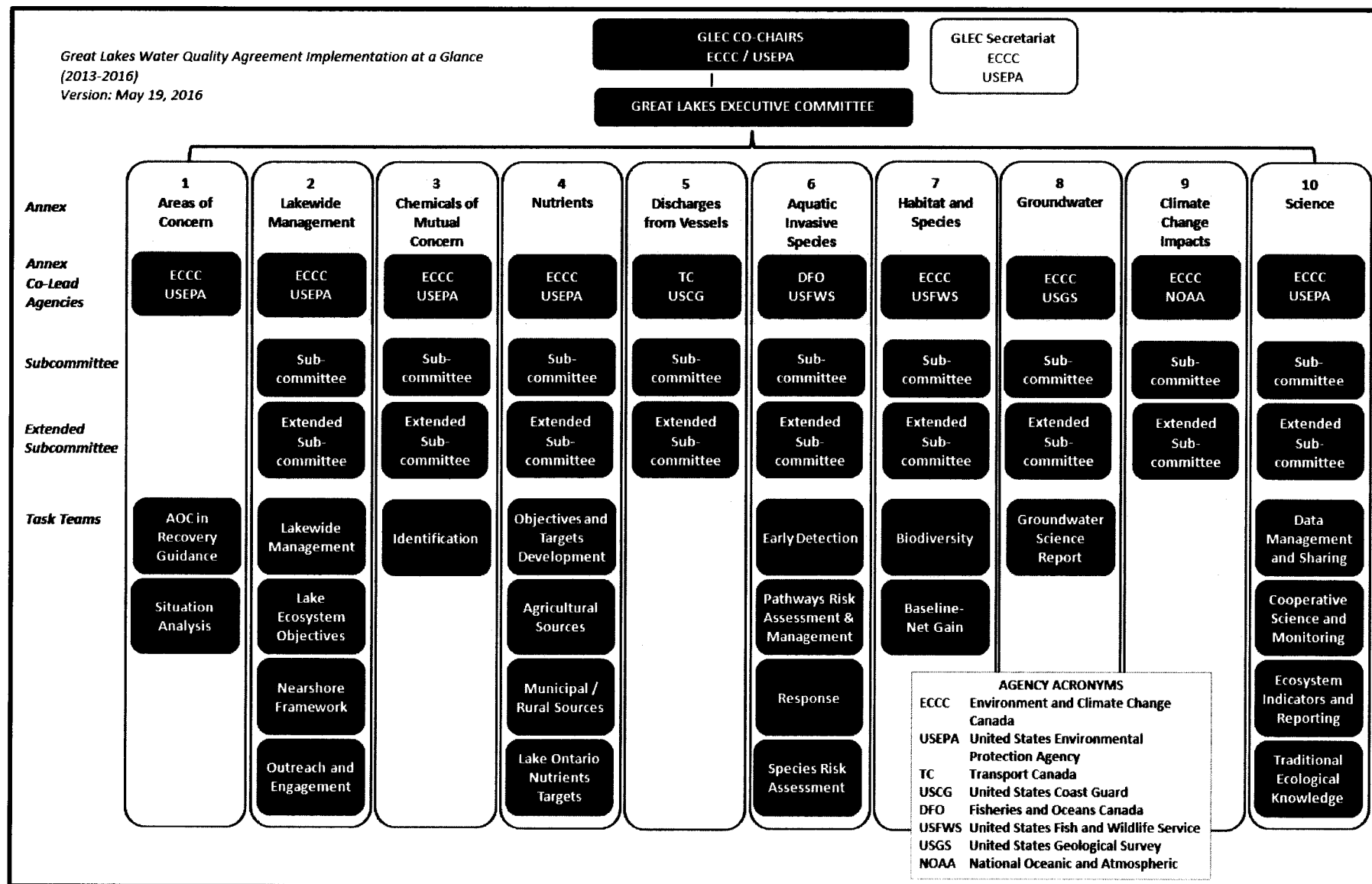
the Great Lakes will be presented at the Great Lakes Public Forum in October, 2016 for public review and comment. A final *State of the Great Lakes* report will be available in 2017.

- The 2012 GLWQA also calls for the development of lake-specific ecosystem objectives, to serve as benchmarks against which to assess status and trends in ecosystem health. Work has begun on development of Lake Ecosystem Objectives for Lake Erie. Finalization of these objectives will include extensive consultation and engagement. Work to develop Lake Ecosystem Objectives for Lakes Huron, Ontario, Michigan and Superior will follow.

Article 5(2)(a) & (b): Establishing the Great Lakes Executive Committee

- A Great Lakes Executive Committee (GLEC) was established to replace the former Binational Executive Committee. The GLEC has a significantly expanded membership and now includes senior-level representatives from the Governments of the United States and Canada, state and provincial governments, tribal governments, First Nations, Métis, municipal governments, watershed management agencies, and other local public agencies. The inaugural meeting of the GLEC was held on December 5-6, 2012 in Toronto, Ontario. The GLEC has met biannually since then, alternating meeting locations between Chicago, Illinois, and Toronto, Ontario. Summaries of the past GLEC meetings are available at binational.net (<https://binational.net/category/mtg-ru/>).
- The GLEC provides a forum for members to share information and discuss issues relevant to the implementation of the Agreement. The meetings have been instrumental in coordinating the activities of departments, agencies, organizations and peoples represented in the GLEC membership. Meetings are open to the public and regularly attract attendance from observers – such as the International Joint Commission, the Great Lakes Commission, the Great Lakes Fishery Commission, the Province of Quebec, environmental non-governmental organizations, industry representatives and members of the interested public – which have provided significant contributions and advice to the GLEC.
- The GLEC has created a formal Subcommittee structure to engage member organizations and others in working binationally to plan and coordinate actions to implement the ten Annexes contained in the 2012 GLWQA. Annex-specific Subcommittees are co-led by a United States and Canadian representative. Extended Subcommittees have been created to advise and provide input to the Annex Co-Leads and to the Annex Subcommittee. Task Teams, reporting to the Subcommittee have been formed to perform specific tasks required to meet the Annex's commitments. The Annex Subcommittee structure, through its engagement of a large number of organizations and individuals, has allowed a significant amount of work to be accomplished over the first three years of the implementation of the 2012 GLWQA. This work will be discussed in subsequent chapters of this report. Figure 2 depicts the Annex Subcommittees, Extended Subcommittees, and the Task Teams that existed for each Annex between 2013 and 2016.

Figure 2 – Great Lakes Water Quality Agreement Implementation at a Glance (2013-2016).



Subcommittees, consisting of representatives from GLEC member agencies and organizations, assist the Annex Co-Leads in coordinating and undertaking activities in support of meeting commitments of the Annexes.

Extended Subcommittees, consisting of representatives from GLEC member agencies and organizations and other entities, advise and provide input to the Annex Co-Leads and Subcommittees.

Task Teams, consisting of representatives from GLEC member agencies and organizations and other entities, are established to perform specific tasks over a specified period of time, as required to meet Annex commitments.

Article 5(2)(c): Creating Binational Priorities for Science and Action

- The process of developing binational priorities builds consensus on the essential science and action required to restore and protect Great Lakes water quality and ecosystem health. In addition, communicating clear priorities enables GLEC members to engage others in working cooperatively to achieve the science and action priorities. The United States and Canada presented proposed binational priorities for science and action for public input at the 2013 Great Lakes Public Forum on September 9-10, 2013. The 2014-2016 binational priorities for science and action were subsequently finalized and posted on binational.net (www.binational.net/2014/03/20/psa-pasa-2014) in March 2014.
- The Parties' proposed binational priorities for science and action for 2017-2019 will be presented at the 2016 Great Lakes Public Forum for public input.

Article 5(1): Convening a Great Lakes Public Forum

- The United States and Canada held the first Great Lakes Public Forum on September 9-10, 2013. The Forum provided an opportunity for the United States and Canada to discuss and seek public comment on the state of the lakes and binational priorities for science and action. The 2013 Forum also provided an opportunity for the International Joint Commission to discuss the Parties' progress reporting and the Commission's assessment of progress. Further information on the 2013 Forum, including the agenda and other materials are available at binational.net (www.binational.net/2013/10/01/great-lakes-public-forum-2013).
- The second Great Lakes Public Forum will be held on October 4-6, 2016 in Toronto, Canada. The Forum will provide an opportunity for the Parties to report on, and for public input on: progress in relation to the implementation of the 2012 GLWQA; the state of the Great Lakes; and priorities for science and action.

Article 5(3): Convening a Great Lakes Summit

- The GLWQA commits the United States and Canada to convening "Summits" between the Parties to the GLWQA and the Great Lakes-related commissions: the Great Lakes Commission, the Great Lakes Fishery Commission and the International Joint Commission. The purpose of

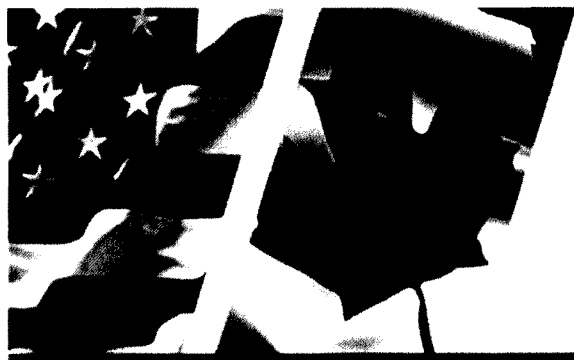
these meetings is to promote increased coordination and effectiveness in the environmental management of the Great Lakes. The first Summit was held on September 11, 2013, and included discussion of: 1) the missions, roles and responsibilities of the Commissions in relation to the GLWQA; 2) opportunities for enhanced collaboration between the Commissions and the United States and Canada on Lakewide Action and Management Plans; 3) coordination of the science and monitoring undertaken by the United States, Canada and the Commissions; and, 4) use of emerging tools and gap analyses in addressing excessive nutrient levels in Lake Erie.

- Building on the commitment to hold formal Summit meetings, the United States and Canada have increased their engagement with the Commissions by holding meetings with the Commissions in conjunction with the biannual GLEC meetings, as well as holding other *ad hoc* meetings to discuss GLWQA-related issues. A special focus of attention has been enhancing coordination and cooperation between the Parties and the Commissions on Lakewide Management activities under Annex 2.
- A 2016 Great Lakes Summit will occur in conjunction with the October 2016 Great Lakes Public Forum to continue the successful dialogue between the United States and Canada and the Commissions.

Article 6: Providing Notification of Planned Activities that Could Lead to a Pollution Incident or Have a Significant Cumulative Impact on the Waters of the Great Lakes

- Pursuant to Article 6(c), the United States and Canada have implemented procedures to provide for notification of planned activities that could lead to a pollution incident or that could have a significant cumulative impact on the waters of the Great Lakes. Proposed notifications are solicited from GLEC members and observers on a quarterly basis. A list of notifications is available at <https://binational.net/2015/05/06/notifications/>.
- The notification process has been successful in ensuring that GLEC members and observers are aware of significant events and development occurring within the Great Lakes basin and of opportunities to engage in applicable review and approval processes.

2016



AREAS OF CONCERN ANNEX

PROGRESS REPORT OF THE PARTIES

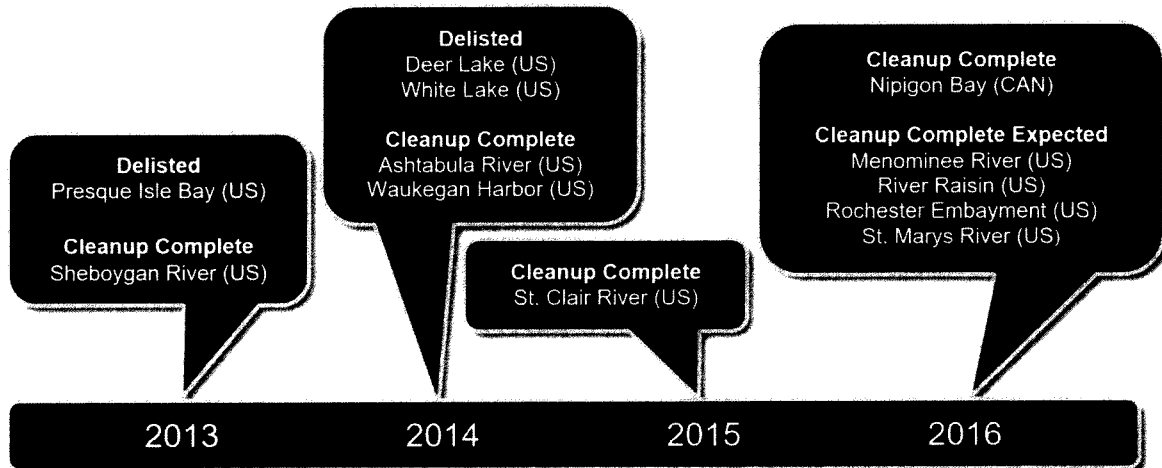
OVERVIEW

Pursuant to the 1987 GLWQA, the Parties designated a total of 43 Areas of Concern (AOCs), 12 in Canada, 26 in the United States, and five that are shared by both countries (as seen in Figure 3). AOCs are regarded as the most environmentally degraded sites within the Great Lakes, based upon a systematic assessment of “beneficial use impairments” (a reduction in the chemical, physical or biological integrity of the waters of the Great Lakes). These sites contribute to degradation on a lakewide and Great Lakes ecosystem wide basis. The 2012 GLWQA reaffirms the commitment of Canada and the United States to restore water quality and ecosystem health in Great Lakes AOCs. The Parties have made significant progress under this Annex in the last three years. Implementation of the Area of Concern Annex is co-led by Environment and Climate Change Canada and the United States Environmental Protection Agency.

Fourteen Beneficial Use Impairments (BUIs) contributing to a location's designation as an AOC:

- Restrictions on fish and wildlife consumption;
- Tainting of fish and wildlife flavour;
- Degradation of fish wildlife populations;
- Fish tumours or other deformities;
- Bird or animal deformities or reproduction problems;
- Degradation of benthos (organisms living on lake and river bottoms);
- Restrictions on dredging activities;
- Eutrophication or undesirable algae;
- Restrictions on drinking water consumption, or taste and odour problems;
- Beach closings;
- Degradation of aesthetics (visual appearance and odour);
- Added costs to agriculture or industry;
- Degradation of phytoplankton and zooplankton populations (organisms that provide a crucial source of food to fish);
- Loss of fish and wildlife habitat.

Progress toward Meeting GLWQA Commitments



- Prior to 2013, the Parties restored beneficial uses and delisted four of the 43 AOCs: three in Canada (Collingwood Harbour in 1994; Severn Sound in 2003; and Wheatley Harbour in 2010) and one in the United States (Oswego River in 2006).
- Canada also designated two Canadian AOCs as AOCs in Recovery prior to 2013, signifying that all remedial actions have been completed and monitoring of natural recovery is in progress (Spanish Harbour in 1999 and Jackfish Bay in 2011).
- Between 2013 and 2016, the United States delisted the Presque Isle Bay (Pennsylvania), Deer Lake (Michigan) and White Lake (Michigan) AOCs, signifying that remedial actions were completed and elimination of beneficial use impairments was confirmed through environmental monitoring and assessment.
- The Parties have completed all remedial actions at five other AOCs: Nipigon Bay in Canada; and Sheboygan River (Wisconsin), Waukegan Harbor (Illinois), Ashtabula River (Ohio), and St. Clair River (Michigan) in the United States. With remedial work completed, these five AOCs are now being monitored to determine when the beneficial use impairments have been fully addressed and delisting can occur.
- Work to restore environmental quality is continuing in all remaining AOCs. By 2019, Canada projects the completion of all remedial actions in four additional AOCs: Bay of Quinte, Peninsula Harbour, Niagara River and St. Lawrence River – Cornwall; while the United States expects to complete management actions necessary for delisting in nine additional AOCs: Menominee River, River Raisin, Rochester Embayment, St. Marys River, Black River, Buffalo River, Clinton River, Manistique River and Muskegon Lake.

Binational Actions Taken

- Efforts to restore the 43 AOCs have been underway for over 25 years. Working with provincial, state and local governments, tribes, First Nations and community members and stakeholders, Canada and the United States have made significant progress in assessing beneficial use impairments, identifying their causes, engaging local communities in developing Remedial Action Plans (RAPs), and implementing actions to restore beneficial uses of the environment. Actions to restore AOCs are primarily carried out domestically; however, Canada and the United States share information on approaches and lessons learned on an ongoing basis in order to increase the efficiency and effectiveness of AOC remediation efforts in both countries.

Supporting Overall Implementation of AOC Remediation

- A guidance document was developed to provide advice on the process, principles, challenges and roles and responsibilities for designating an AOC as an AOC in Recovery. The document identifies five factors to be considered in designating an AOC as an AOC in Recovery: 1) restoration actions needed; 2) achievability of delisting criteria; 3) monitoring; 4) estimated time for recovery; and 5) consideration of stakeholder input. The document will contribute to ensuring a consistent approach in future designations of AOCs in recovery.
- A Situation Analysis report was completed to document how AOC restoration activities are currently being implemented in Canada and the United States, including a review and comparison of agency roles and practices; status of and processes for RAPs, including delisting criteria, BUI removals, AOC delisting and public involvement; key challenges, targets and objectives; and recommendations on guidance needs and information sharing. The document will assist agencies in implementing continuous improvements to current practices.

Domestic Actions Taken



- Within Canada, Environment and Climate Change Canada and the Ontario Ministry of Environment and Climate Change share the lead for implementation of AOC remediation efforts, with support from other federal departments (e.g., Fisheries and Oceans Canada), provincial ministries (e.g., Ministry of Natural Resources and Forestry), municipalities, conservation authorities, Indigenous peoples, and community stakeholders. Progress is being made in all Canadian AOCs. Table 1 shows that a total of 65 impairments of beneficial uses of the environment have been eliminated, with 81 impairments remaining. In 2016 to 2017, Canada anticipates removing up to 15 more beneficial uses currently deemed impaired, which will add to the 65 beneficial use impairments already removed across the 17 AOCs outlined in Table 1. Table 2 shows the categories of remaining actions required in each Canadian AOC and their status.
- In 2015, in-water construction began on the largest contaminated sediment remediation project ever undertaken in a Canadian AOC. Through a public-private partnership, the project will clean up 700,000 cubic meters of severely contaminated sediment in the Hamilton Harbour AOC. It will significantly improve water quality and fish and wildlife habitat and also bring economic and

social benefits to the community through enhanced shipping and port facilities, business development, job creation, and increased recreational opportunities.

- Another major contaminated sediment remediation project in Canada is in the Port Hope AOC, where the Government of Canada has committed \$1.28 billion over 10 years to the cleanup and safe long-term management of 1.7 million cubic meters of historic low-level radioactive waste, which will restore beneficial uses of the ecosystem and result in the delisting of the Area of Concern. The Port Hope Area Initiative is on track with the Port Hope Harbour clean-up and dredging underway as planned. The harbor walls will be supported and repaired in 2019 with dredging, cleanup and placement of these radioactive materials into the long-term waste management facility in 2020.
- Other notable accomplishments in Canadian AOCs during the 2013 to 2016 period include restoring close to 4 kilometers of shoreline habitat and enhancing almost 180 hectares of coastal wetlands and fish spawning grounds; investing almost \$562 million in upgrades to municipal wastewater treatment plants to significantly reduce nutrients, suspended solids and pollutants entering AOC waterways; and improving water quality and aesthetics by better managing urban and rural non-point sources of pollution in a number of AOCs. There are many community groups engaged in cleaning up AOCs, and the success of many of the projects undertaken are in large part the result of enduring support and partnerships at all levels. More information on the status of beneficial use impairments in Canadian AOCs, projects completed, and remaining issues to be addressed can be found at www.ec.gc.ca/raps and in Figure 4 on the following page.

Figure 4 – Examples of Habitat, Wastewater and Non-point Source Domestic Actions in Canadian AOCs.





		
Habitat	Wastewater	Non-point sources
<p>To help improve aquatic habitat and fish populations, Canada and its partners restored close to 4 kilometers of shoreline habitat and almost 180 hectares of coastal wetlands and fish spawning grounds in a number of AOCs, including:</p> <ul style="list-style-type: none"> • 19 habitat enhancement projects in the Bay of Quinte AOC that created two ponds, wetlands, 675 meters of vegetative buffer zones, and naturalized 40 meters of shoreline; • re-establishing a natural channel from the Nipigon River to a lagoon to restore 3.8 hectares of spawning and nursery habitat for fish in the Nipigon Bay AOC; • restoring 165 hectares of coastal wetland in the St. Clair River AOC; • restoring 3 kilometers of shoreline in the Toronto Region AOC and transforming a disposal site for contaminated sediment into 9.3-hectares of prime wetland on the Toronto waterfront once fully completed in 2018; and • through binational collaboration, constructing a second fish spawning reef in the Detroit River AOC adjacent to the existing one at Fighting Island that creates almost one hectare of new spawning habitat for fish. 	<p>To help improve water quality and aesthetics, Canada, Ontario and local governments invested almost \$562 million in upgrades to municipal wastewater treatment plants in a number of AOCs, including:</p> <ul style="list-style-type: none"> • building a new facility in the St. Clair River AOC (\$34.5 million); • upgrading to secondary treatment a facility in the Nipigon River AOC and Detroit River AOC (\$9 million and \$34 million, respectively); and • upgrading two facilities to tertiary treatment in the Hamilton Harbour AOC (\$154 million for one in Burlington; \$330 million for one in Hamilton now underway and to be completed in 2021). 	<p>To help improve water quality and aesthetics, Canada and its partners are addressing non-point sources of pollution in a number of AOCs, including:</p> <ul style="list-style-type: none"> • implementing stormwater management plans and programs to better manage urban runoff and reduce pollution entering the waterways in the St. Marys River and Bay of Quinte AOCs; • separating storm and sanitary sewers in the St. Clair River AOCs; and • supporting citizen-driven efforts such as septic inspections and targeted Best Management Practices to reduce rural non-point source pollution in the Bay of Quinte AOC and community rain gardens to better manage rainfall and lower pressure placed upon storm sewers and wastewater treatment plants in the Detroit River AOC.

Table 1 – Status of Beneficial Use Impairments in the Canadian Great Lakes Areas of Concern.

AOC	Restrictions on fish & wildlife consumption	Tainting of fish & wildlife flavour	Degradation of fish & wildlife populations	Fish tumours or other deformities	Bird/animal deformities or reproduction problems	Degradation of benthos	Restrictions on dredging activities	Eutrophication or undesirable algae	Restrictions - drinking water consumption, taste/odour problems	Beach Closings	Degradation of aesthetics	Added costs to agriculture or industry	Degradation of phyto- and zooplankton populations	Loss of fish & wildlife habitat	Original Total	Total Removed	Remaining Total
Thunder Bay												2004			10	1	9
Nipigon Bay - Completed		1995	2016	1995		2016	1995	2016			2016			2016	8	8	0
Jackfish Bay - In Recovery				2010	2010		1998								8	3	5
Peninsula Harbour				2012			2012								6	2	4
St. Marys River					2016										10	1	9
Spanish Harbour - In Recovery			1999		1999					1999		1999	1999	1999	9	6	3
Severn Sound - Delisted	2002		2002				2002	2002			2002			2002	6	6	0
Collingwood Harbour - Delisted	1994		1994		1994	1994	1994	1994		1994	1994		1994	1994	10	10	0
St. Clair River		2011									2016	2012			9	3	6
Detroit River		2014							2011	2016	2016	2011			12	5	7
Wheatley Harbour - Delisted	2010		2010			2010	2010	2010						2010	6	6	0
Niagara River				2009	2009		2009								9	3	6
Hamilton Harbour															10	0	10
Toronto and Region				2011	2011	2016	2016								10	4	6
Port Hope Harbour															1	0	1
Bay of Quinte															10	0	10
St. Lawrence River		1997			2007	2007	2007		1997		1997	1997			12	7	5
Original Total	15	4	15	9	9	15	17	10	4	11	12	5	4	16	146		
Total Removed	3	4	5	5	7	5	9	4	2	3	6	5	2	5		65	
Remaining Total	12	0	10	4	2	10	8	6	2	8	6	0	2	11			81

 BUI Removed


 BUI Impaired

Table 2 – Status of Actions in Canadian Great Lakes Areas of Concern.

AOC	Sediment Cleanup / Remediation	Habitat Restoration	Municipal / Industrial WW Treatment	Non-point-source Pollution Management	Studies/ Investigations	BUI Evaluation/ Assessment	Follow-up Monitoring	Year RAP actions were or will be completed
Thunder Bay								beyond 2020
Nipigon Bay								Delisting expected in 2016
Jackfish Bay (in recovery)				N/A				beyond 2020
Peninsula Harbour				N/A				2019
St. Marys River								beyond 2020
Spanish Harbour (in recovery)								beyond 2020
St. Clair River								2020
Detroit River								2020
Niagara River								2019
Hamilton Harbour								beyond 2020
Toronto Region								beyond 2020
Port Hope		N/A	N/A	N/A				beyond 2020
Bay of Quinte								2019
St. Lawrence River (at Cornwall)								2019

These Canadian AOCs are already delisted: Collingwood Harbour (1994), Severn Sound (2003), and Wheatley Harbour (2010).



For Canadian and binational AOCs, go to: www.ec.gc.ca/raps.



- AOC clean-up efforts in the U.S. are led by the United States Environmental Protection Agency, with significant contributions from other federal agencies (*i.e.*, National Oceanic and Atmospheric Administration, the United State Army Corps of Engineers), states, local governments and communities, and non-governmental organizations.
- Table 3 shows that a total of 62 impairments of beneficial uses of the environment have been removed, with 193 impairments remaining. Table 4 shows the categories of remaining actions required in each U.S. AOC and their status. Between 1987 and 2010, only one U.S. AOC was delisted.

However, since the inception of GLRI, three additional AOCs have been delisted and management actions have been completed at four additional U.S. AOCs. In addition, the Environmental Protection Agency projects that management actions will be completed at nine more AOCs by 2019. This remarkable pace of AOC restoration is due to the GLRI. First, the GLRI appropriation language makes clear that cleaning up and restoring AOCs is a priority. Second, federal agencies have been able to utilize over \$650 million in GLRI funding to pay for this work.

Table 3 – Status of Beneficial Use Impairments in the U.S. Great Lakes Areas of Concern.

AOC	State	Restriction on fish & wildlife consumption	Tainting of fish & wildlife flavor	Degraded fish & wildlife populations	Fish tumor or other deformities	Bird & animal deformities or reproduction problems	Degradation of benthos	Restrictions on dredging activities	Eutrophication or undesirable algae	Restrictions – drinking water consumption, taste/odor problems	Beach Closings	Degradation of aesthetics	Added costs to agriculture or industry	Degradation of phyto- and zooplankton	Loss of fish and wildlife habitat	Original Total	Total Removed	Remaining Total
Waukegan Harbor	IL							2014			2011				2013	6	3	3
Grand Calumet River	IN									2012			2011			14	2	12
Clinton River	MI															8	0	8
Deer Lake	MI	2014				2011			2011							3	3	0
Detroit River	MI		2013							2011						11	2	9
Kalamazoo River	MI										2011	2012				8	2	6
Manistique River	MI						2007				2010				2008	5	3	2
Muskegon Lake	MI	2013						2011		2013	2015					9	4	5
River Raisin	MI			2015					2013		2013	2012			2015	9	5	4
Rouge River	MI															9	0	9
Saginaw River & Bay	MI		2008							2008					2014	12	3	9
Torch Lake	MI				2007											3	1	2
White Lake	MI	2013		2014			2012	2011	2012	2014		2014			2014	8	8	0
St. Clair River	MI/ON		2010				2015	2011				2012	2012			10	5	5
St. Marys River	MI/ON					2014						2014				10	2	8
Menominee River	MI/WI										2011					6	1	5
Buffalo River	NY															9	0	9
Eighteenmile Creek	NY															5	0	5
Oswego River	NY	2006		2006					2006						2006	4	4	0
Rochester Embayment	NY				2015					2011			2011			14	3	11
Niagara River	NY/ON				2016											7	1	6
St. Lawrence River	NY/ON													2015		7	1	6
Ashtabula River	OH	2014		2014											2014	6	3	3
Black River	OH															9	0	9
Cuyahoga River	OH															9	0	9
Maumee River	OH												2015			10	1	9
Presque Isle	PA				2013			2007								2	2	0
Fox River/ S Green Bay	WI															13	0	13
Milwaukee Estuary	WI															11	0	11
Sheboygan River	WI							2015	2016							9	2	7
St. Louis River & Bay	WI/MN											2014				9	1	8
Original Total		30	7	25	18	17	27	27	18	8	20	19	4	8	27	255		
Total Removed		5	3	4	4	2	3	6	5	6	6	6	4	1	7		62	
Remaining Total		25	4	21	14	15	24	21	13	2	14	13	0	7	20			193

BUI Removed

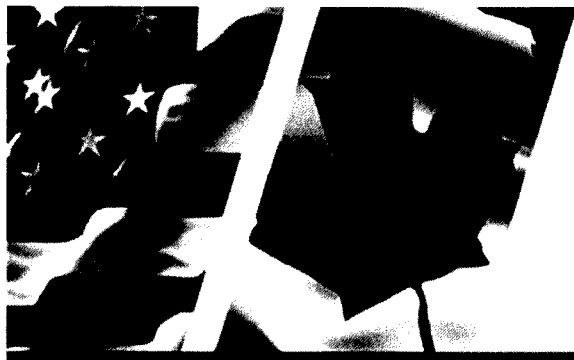
BUI Impaired

Table 4 – Status of Actions in U.S. Great Lakes Areas of Concern.

AOC	State	Sediment Remediation	Habitat Restoration	Hydrologic Controls/Diversions	Safe Drinking Water Provided	Engineering Design	Studies/Investigations	Other Regulatory Action	BUJ Evaluation/Assessment	Year all remediation and restoration actions were or will be completed
Waukegan Harbor	IL			N/A	N/A					2014
Grand Calumet River	IN			N/A	N/A					2020
Clinton River	MI	N/A		N/A	N/A			N/A		2017
Deer Lake	MI				N/A					Delisted 2014
Detroit River	MI			N/A	N/A					2023
Kalamazoo River	MI			N/A	N/A					2030+
Manistique River	MI		N/A	N/A	N/A			N/A		2018
Muskegon Lake	MI			N/A	N/A			N/A		2018
River Raisin	MI			N/A	N/A			N/A		2016
Rouge River	MI			N/A	N/A					2021
Saginaw River & Bay	MI									2030+
Torch Lake	MI		N/A	N/A	N/A	N/A				2030+
White Lake	MI			N/A	N/A	N/A		N/A		Delisted 2014
St. Clair River	MI/ON	N/A		N/A	N/A			N/A		2015
St. Marys River	MI/ON			N/A	N/A			N/A		2016
Menominee River	MI/WI				N/A					2016
Buffalo River	NY			N/A	N/A					2017
Eighteenmile Creek	NY		N/A		N/A					2026+
Oswego River	NY	N/A	N/A		N/A	N/A				Delisted 2006
Rochester Embayment	NY				N/A					2016
Niagara River	NY/ON			N/A	N/A					2026+
St. Lawrence River	NY/ON			N/A	N/A					2026+
Ashtabula River	OH			N/A	N/A	N/A		N/A		2013
Black River	OH			N/A	N/A			N/A		2017
Cuyahoga River	OH			N/A	N/A					2021
Maumee River	OH			N/A	N/A			N/A		2025
Presque Isle	PA			N/A	N/A	N/A		N/A		Delisted 2013
Fox River/ S Green Bay	WI				N/A					2026+
Milwaukee Estuary	WI			N/A	N/A					2026+
Sheboygan River	WI			N/A	N/A					2013
St. Louis River & Bay	WI/MN			N/A	N/A					2020



For Canadian and binational AOCs, go to: www.epa.gov/great-lakes-aocs/list-aocs



LAKEWIDE MANAGEMENT ANNEX

2016

PROGRESS REPORT OF THE PARTIES


OVERVIEW

The Great Lakes are comprised of five of the twenty largest lakes in the world by volume: Superior (3), Michigan (7), Huron (8), Ontario (12) and Erie (18). The Great Lakes are connected and discharge through major river systems: the St. Marys, St. Clair (including Lake St. Clair), Detroit, Niagara and St. Lawrence. Given the size and ecological complexity of the lakes, restoring and protecting Great Lakes water quality and ecosystem health sometimes requires an approach that is specifically tailored to an individual lake.

In the Lakewide Management Annex of the 2012 GLWQA, the United States and Canada commit to establishing Lakewide Action and Management Plans (LAMPs) for each of the five Great Lakes and their connecting river systems. These individualized plans will serve as blueprints for action, as they will identify and prioritize desired restoration and protection activities on each of the Great Lakes.

This Annex's implementation is supported by the Lakewide Management Annex Subcommittee, co-led by the United States Environmental Protection Agency and Environment and Climate Change Canada. Organizations on the Extended Subcommittee include: **United States Environmental Protection Agency**, Alliance for the Great Lakes, Chippewa-Ottawa Resource Authority, Great Lakes Indian Fish and Wildlife Commission, Great Lakes-St. Lawrence Cities Initiative, Illinois Department of Natural Resources, Michigan Department of Environmental Quality, Minnesota Pollution Control Agency, New York State Department of Environmental Conservation, Ohio Environmental Protection Agency, Pennsylvania Department of Environmental Protection, United States Army Corps of Engineers, United States Geologic Survey, United States National Oceanic and Atmospheric Administration, Wisconsin Department of Natural Resources, **Environment and Climate Change Canada**, Conservation Ontario, Fisheries and Oceans Canada, Métis Nation of Ontario, Ontario Ministry of Agriculture, Food and Rural Affairs, Ontario Ministry of the Environment and Climate Change, and the Ontario Ministry of Natural Resources and Forestry, Parks Canada, McMaster University, Ontario Federation of Anglers and Hunters, as well as Observers from the Great Lakes Commission, Great Lakes Fishery Commission, and International Joint Commission.

Progress toward Meeting GLWQA Commitments



2012	2013	2014	2015	2016
Published LAMP Annual Reports.	Published LAMP Annual Reports.	Published LAMP Annual Reports.	Published LAMP Annual Reports.	Published LAMP Annual Reports.
Established Lake Ontario Science and Monitoring Priorities.	Established Lake Michigan Science and Monitoring Priorities.	Established Lake Superior Science and Monitoring priorities.	Established Lake Huron Science and Monitoring priorities.	Finalized Lake Superior LAMP.
Finalized Lake Michigan Biodiversity Conservation Strategy.	Finalized Lake Erie Biodiversity Conservation Strategy.		Finalized Lake Superior Biodiversity Conservation Strategy.	Finalized Nearshore Framework.

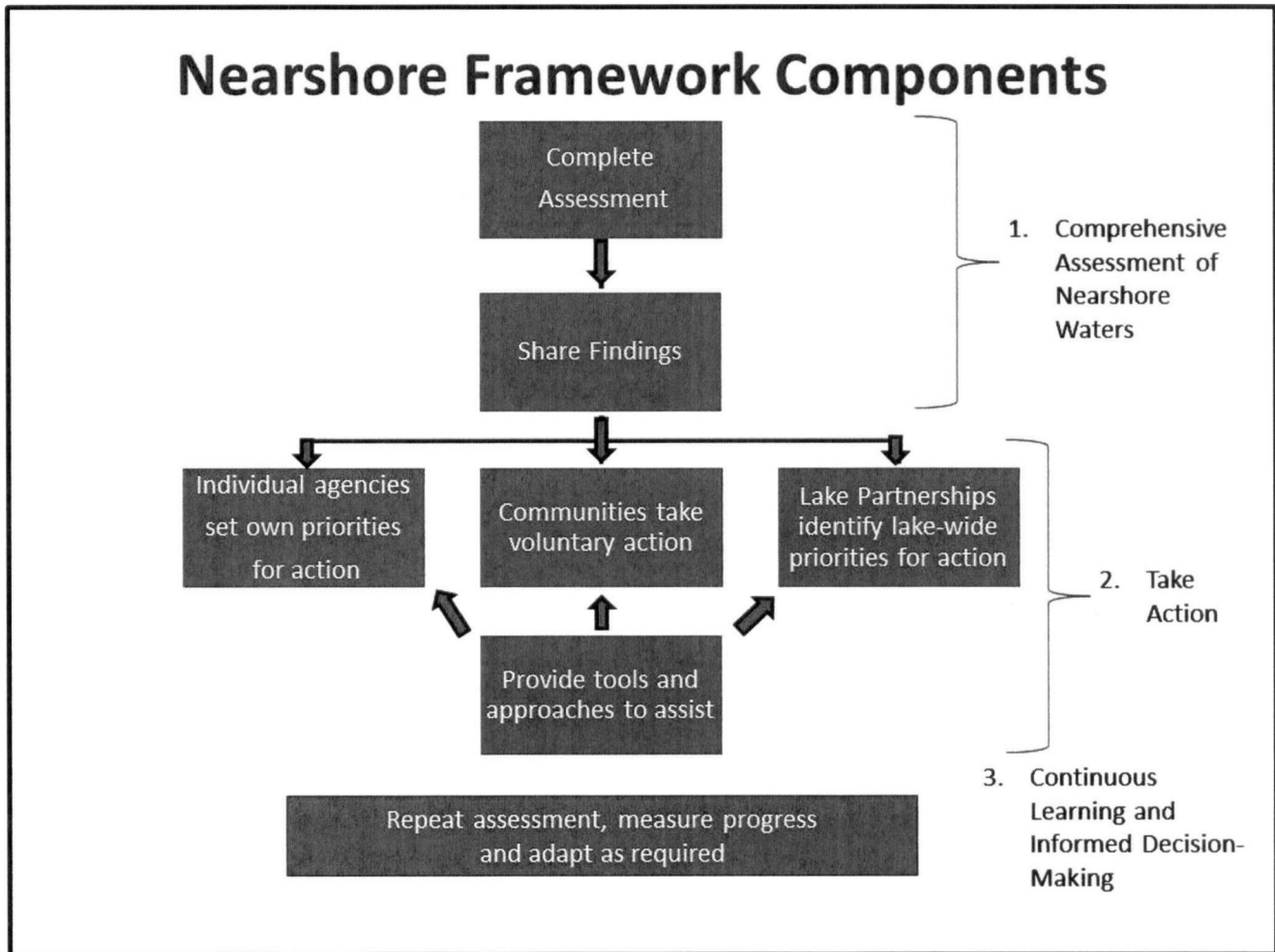
Binational Actions Taken

Developing a nearshore framework to identify areas of high ecological value and those that are or may become subject to severe stress due to the cumulative effects of multiple stressors.

- The fragility of the nearshore as a key issue in the Great Lakes basin was highlighted in 2005 by more than 250 Great Lakes scientists who signed on to a report entitled *Prescription for Great Lakes Ecosystem Protection and Restoration (Avoiding the Tipping Point of Irreversible Changes)* (<http://www.miseagrant.umich.edu/downloads/habitat/Prescription-for-the-Great-Lakes-08-2006.pdf>).
- To develop the Nearshore Framework, the United States and Canada undertook a three-year process to engage a wide range of people and organizations throughout the Great Lakes basin. The resulting Nearshore Framework was approved by the United States and Canada in July 2016. Components of the Nearshore Framework are identified in Figure 5. The Parties will pilot test implementation of the framework in Lake Erie beginning in 2017.
- The Nearshore Framework provides a mechanism for undertaking a systematic, integrated and collective approach for assessing nearshore health and identifying and communicating cumulative impacts and stresses.
- Building on the information provided by the assessment, federal, state and provincial governments, tribal governments, First Nations, Métis, municipal governments, watershed

management agencies, local public agencies and the public, individually and collectively, will be able to identify management priorities, take action to protect nearshore areas of high ecological value, protect water quality, and restore degraded areas.

Figure 5 – Components of the Great Lakes Nearshore Framework.



Developing the Lake Superior Lakewide Action and Management Plan.

- The schedule for the development and release of Lakewide Action and Management Plans (LAMPs) was confirmed in 2014. The Lake Superior LAMP was approved in June of 2016, and is the first LAMP completed under the 2012 GLWQA. It is an important source of information for the Lake Superior ecosystem.
- The Lake Superior LAMP was developed with the help of over 30 science-based government agencies and involvement from over 50 other organizations, representing thousands of people and many diverse interests.

- The Lake Superior ecosystem continues to be in good condition, as exemplified by the good condition of the fisheries, including self-sustaining populations of Lake Trout and increasing abundance of Lake Sturgeon, and a robust lower food web. The ecological status of most major habitats is good on a lakewide scale, including coastal wetlands. The concentrations of legacy contaminants are generally decreasing or stable. The LAMP also details ongoing and emerging threats to the ecosystem, including aquatic invasive species, climate change, loss of habitat connectivity, and chemical contaminants.
- Science priorities identified in the Lake Superior LAMP include: confirming lower food-web health and stability; determining progress being made on reducing nine persistent, bioaccumulative and toxic substances; determining progress being made on Lake Sturgeon rehabilitation; providing information needed to support implementation of fish rehabilitation plans; assessing baseline water quality conditions in areas of critical habitat and potentially significant land-use change; and identifying vulnerable cold-water tributaries to Lake Superior from various stressors such as climate change.
- To maintain the good condition of the Lake Superior ecosystem, and address threats to water quality and ecosystem health, the LAMP includes priority actions in the form of 29 projects expected to be undertaken over the next five years through cooperative implementation among government agencies and others. Actions that the public can take are also identified.

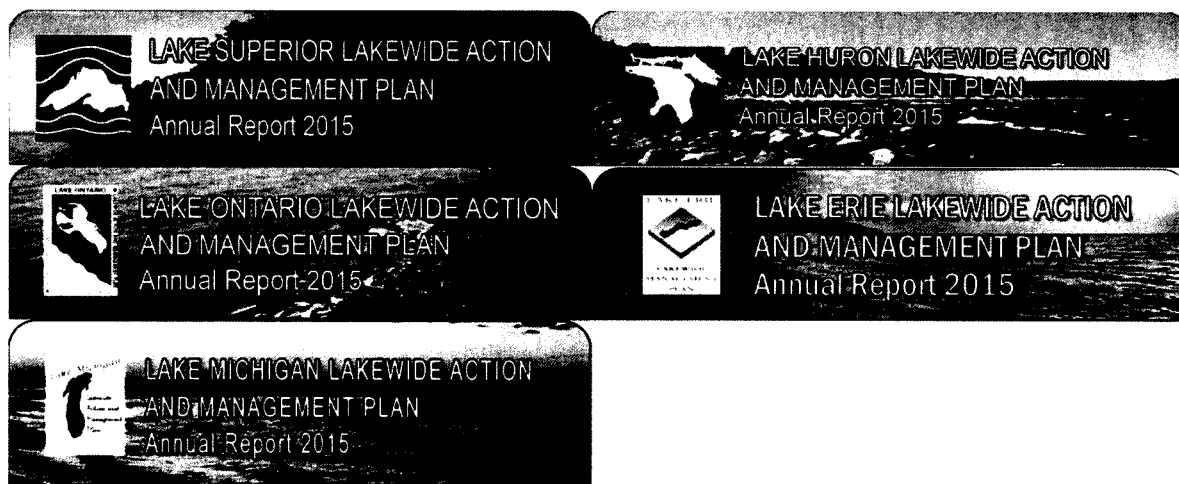
Establishing Lake Ecosystem Objectives for each Great Lake, including its connecting river systems, as a benchmark against which to assess status and trends in water quality and lake ecosystem health.

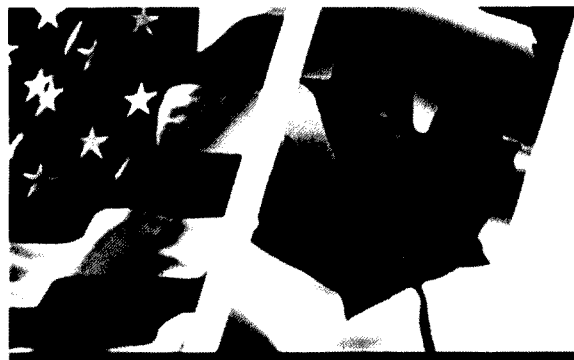
- In October of 2014 a draft guidance document for the development of Lake Ecosystem Objectives (LEOs) and a draft framework linking the LEOs to the Agreement's General Objectives and the State of the Great Lakes Indicators were developed.
- The guidance suggests that LEOs should:
 - Be practical and attainable or achievable within a 20-year timeframe;
 - Provide sufficient direction for implementing LAMP actions;
 - Have support from the agencies that implement the programs used to achieve the objective;
 - Be based on sound, readily available data, so they can be reported on every five years; and,
 - Taken together, be a comprehensive suite which addresses each 2012 GLWQA General Objective and lake stressor.
- A binational team has been formed to develop a draft suite of LEOs for Lake Erie for consultation.
- LEOs for the other lakes will be developed during the next reporting cycle (2017 to 2019).

Undertaking the lakewide management actions in cooperation and consultation with others.

- The United States and Canada have undertaken outreach and engagement activities through the work of the Lake Partnerships and the Annex Subcommittee.
- In 2015, eight webinars involving over 800 participants were held to update the basin-wide and individual lake stakeholder communities about progress under the Lakewide Management Annex, and to discuss possible approaches to outreach and engagement. Outreach and Engagement Subcommittees were formed under each Lake Partnership to develop and implement an outreach and engagement strategy for each lake.
- In 2016, the Parties solicited interest from stakeholders in participating with the Lake Partnerships, including providing input on LAMP development and other Partnership activities to simply being kept apprised of Lake Partnership activities and receiving notice of requests for input on specific issues. The solicitation was sent through existing Great Lakes-related email distribution lists including GLIN-Announce, and the United States Environmental Protection Agency's and Environment and Climate Change Canada's Great Lakes email databases in order to reach a wide breadth of stakeholders. Almost 400 stakeholders responded to this additional outreach and engagement opportunity. In September 2016, stakeholder calls were held for each Great Lake.
- In 2016 the Parties also advised the Great Lakes community that the Lake Huron LAMP was being developed, and offered opportunities for input.
- In 2013, 2014, and 2015, LAMP Annual Reports were issued to provide an overview of accomplishments and challenges facing each lake. The 2015 LAMP Annual Reports, which are pictured in Figure 6, and the previous LAMP Annual Reports dating back to 2012 are available at www.binational.net (<https://binational.net/category/a2-2/lamps-paaps/>).

Figure 6 – 2015 LAMP Annual Reports.





CHEMICALS OF MUTUAL CONCERN ANNEX

PROGRESS REPORT OF THE PARTIES

2016

OVERVIEW

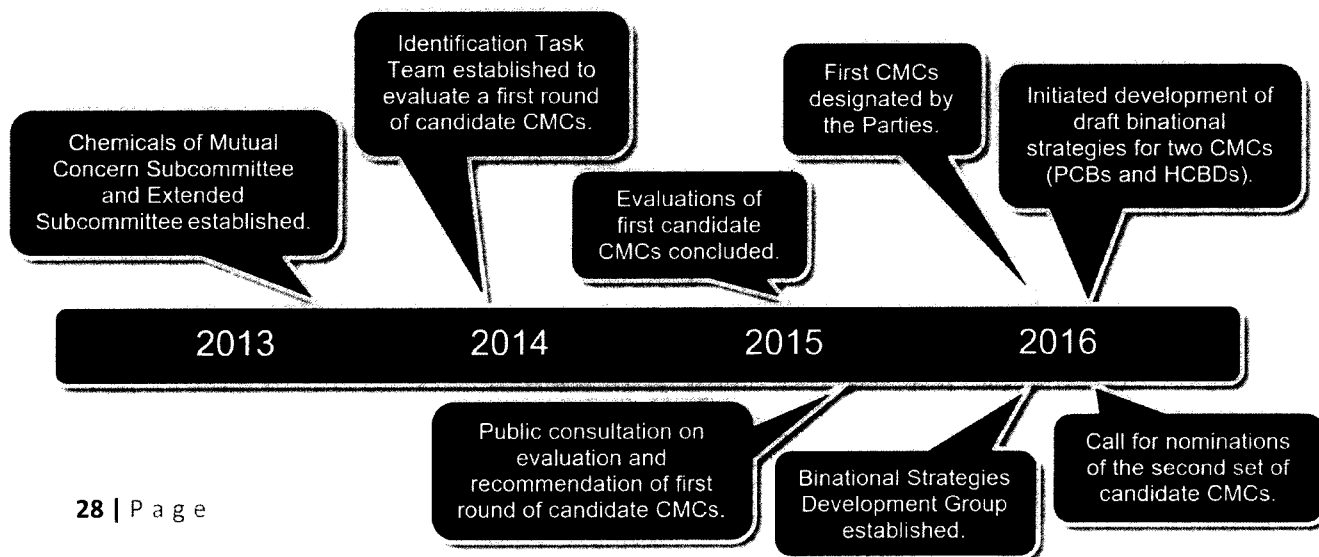
Due to the high population density and concentration of industrial activity in the Great Lakes region, as well as long-range atmospheric transport and deposition from out-of-basin sources and the long residence times of certain chemicals in the environment, chemical pollution has long been a serious concern in the Great Lakes. Certain chemicals can harm aquatic ecosystems and negatively impact habitats and biodiversity throughout the Great Lakes. Some chemicals are persistent and can bioaccumulate in the food web, exposing humans to potentially harmful chemicals through fish consumption. As such, addressing the threats posed to the Great Lakes by chemicals in the environment has been a priority of Canada and the United States since the late 1970's.

The purpose of the Chemicals of Mutual Concern Annex is to contribute to the achievement of the general and specific objectives of the Agreement by protecting human health and the environment through cooperative and coordinated measures to reduce anthropogenic inputs of chemicals of mutual concern (CMCs) into the waters of the Great Lakes.

Under the Chemicals of Mutual Concern Annex, the Parties have committed to:

- Identify CMCs and potential candidate CMCs on an ongoing basis;
- Take specific actions for identified CMCs, including the development of binational strategies, which may include pollution prevention, control and reduction actions as well as research, monitoring and/or surveillance activities; and
- Ensure that research, science, and monitoring and surveillance programs are responsive to CMC identification and management needs.

Progress toward Meeting GLWQA Commitments



The implementation of this Annex is supported by the Chemicals of Mutual Concern Annex Subcommittee, which is co-led by Environment and Climate Change Canada and the United States Environmental Protection Agency and includes state, provincial and tribal governments. The Chemicals of Mutual Concern Annex Subcommittee is supported by an Extended Subcommittee with representation from non-government organizations and industry.

Organizations on the Subcommittee include: Ontario Ministry of Environment and Climate Change, Great Lakes Indian Fish and Wildlife Commission, Indiana Department of Environmental Management, Minnesota Department of Health, Wisconsin Department of Natural Resources. Organizations on the Extended Subcommittee include: Canadian Environmental Law Association, Chemical Industry Association of Canada, Pollution Probe, Council of Great Lakes Industries, Great Lakes Green Chemistry Network, and the National Wildlife Federation.

Binational Actions Taken

Pollution prevention and control of chemicals in Canada and the United States occurs through a number of programs and pursuant to legislation at the federal, provincial, state and local levels. Recognizing this, the 2012 GLWQA focuses attention on those chemicals present in the Great Lakes, for which additional effort are warranted and can be advanced through binational coordination and cooperation.

Identifying chemicals of mutual concern that originate from anthropogenic sources, which are potentially harmful to human health or the environment.

- *Developing Criteria for Evaluation CMCs.* A series of criteria, the *Binational Considerations*, were developed to evaluate candidate CMCs. Using these criteria, a first round of candidate CMCs were evaluated, with detailed reports for eight candidate CMCs posted to binational.net for public input (<https://binational.net/2015/05/13/cmc-cand-pcspm/> – the *Binational Considerations* can be found in Appendix A of each of these eight reports for candidate CMCs).
- *Ensuring Participation in the CMC Evaluation Process.* To ensure that the best science was included within each CMC evaluation, the Parties established an Identification Task Team that provided enhanced stakeholder engagement and involvement during the review of potential CMCs.
- Taking into consideration the information in the detailed reports and input provided by the Chemicals of Mutual Concern Subcommittee, Extended Subcommittee, the Great Lakes Executive Committee and the public, on May 31, 2016, Canada and the United States designated the following eight chemicals as the first set of CMCs under the auspices of the 2012 GLWQA:
 1. Mercury;
 2. Polychlorinated biphenyls (PCBs);
 3. Perfluorooctanoic acid (PFOA),
 4. Perfluorooctane sulfonate (PFOS),
 5. Long-chain perfluorinated carboxylic acids (LC-PFCAs);
 6. Polybrominated diphenyl ethers (PBDEs)
 7. Hexabromocyclododecane (HBCD); and,
 8. Short-chain chlorinated paraffins (SCCPs).

- *Seeking Additional CMC Candidate Substances.* To foster enhanced stakeholder engagement, the Parties created a process by which stakeholders, including non-government organizations, industry, academia and the public, can propose specific chemicals for consideration as potential candidate CMCs. A support document for the external nominations process is available on binational.net (<https://binational.net/2015/05/13/cmc-pro-pcspm/>), which describes the information to be submitted by stakeholders in support of a nomination.

Targeting these identified Chemicals of Mutual Concern for action.

- Draft binational strategies, which may include research, monitoring, surveillance and pollution prevention and control actions, are being developed for all of the CMCs nominated through the first round. Binational strategies for Polychlorinated Biphenyls (PCBs) and Hexabromocyclododecane (HBCD) will be disseminated first to stakeholders, including the public and the remaining strategies will be provided shortly thereafter. Stakeholder and public review and input will contribute to the development of binational strategies.
- The development of binational strategies for the remaining CMCs will take into account lessons learned while developing the first two binational strategies for PCBs and HBCD.
- Existing relevant Canadian and United States environmental quality guidelines (including federal and provincial or state guidelines and other relevant criteria) for CMCs are being compiled and will be made available on binational.net, as binational strategies are finalized and published. These guidelines can be considered in conjunction with other information (e.g., from state of the environment reporting) to evaluate progress towards the implementation of binational strategies for CMCs.

Coordinating science priorities, research, surveillance and monitoring activities, as appropriate related to CMCs ion.

- Through mechanisms such as the Cooperative Science and Monitoring Initiative under the Science Annex, monitoring of CMCs in relevant environmental media of the Great Lakes is being pursued in a collaborative and coordinated manner, whenever possible.
- Monitoring of CMCs supports the commitments of the Chemicals of Mutual Concern Annex, and is also critical for the development of the triennial State of the Great Lakes Indicators report, in which levels of these chemicals in the Great Lakes are reported.
- Canada and the United States have comprehensive national monitoring and surveillance programs, as well as regional, Great Lakes-specific programs and activities, which evaluate a broad suite of chemicals, including more recent chemicals of potential concern (e.g., organic flame retardants and perfluorinated chemicals). National monitoring and surveillance programs incorporated Chemicals of Mutual Concern into their programs, as appropriate.

Domestic Actions Taken



- The Government of Canada continues to assess and manage the risks posed by chemicals, including CMCs, through its national Chemicals Management Plan. Under the Chemicals Management Plan, over 2,750 substances have been assessed, and 363 substances or groups of substances have been concluded to be toxic. For these toxic substances, 78 final risk management instruments have been established, and additional risk management instruments are being developed.
- All designated CMCs are listed under the Schedule 1 – List of Toxic Substances of the *Canadian Environmental Protection Act, 1999*. As such, all
- CMCs are subject to federal risk management in Canada, for example through the *Polychlorinated Biphenyl Regulations* and the *Prohibition of Certain Toxic Substance Regulations*. Additionally, Environment and Climate Change Canada has developed federal environmental quality guidelines and supported the development of federal-provincial guidelines, for many of the first CMCs.
- Canada is a Party to many Multilateral Environmental Agreements aimed at globally addressing environmental and human health impacts of chemicals. Examples of relevant Multilateral Environmental Agreements include the Minamata Convention on Mercury and the Stockholm Convention on Persistent Organic Pollutants.
- Environment and Climate Change Canada also delivers a number of foundational water quality monitoring and surveillance activities in the Great Lakes watershed, including the Great Lakes Surveillance Program, the Great Lakes Fish Contaminant and Sediment Monitoring and Surveillance Programs, Canada Chemicals Management Plan Monitoring and Surveillance Program in the Great Lakes Basin, and the Great Lakes Connecting Channels Program, through which CMCs are currently being monitored in the Great Lakes.



Monitoring and Surveillance

- The United States Environmental Protection Agency delivers a number of foundational water quality monitoring and surveillance activities in the Great Lakes watershed, including the Great Lakes Fish Monitoring and Surveillance Program and the International Atmospheric Deposition Network.

Science and Research

- The United States also has funded, and continues to fund, research on the presence, effects, and trends of emerging chemicals, including CMCs, in a variety of media through the Great Lakes Restoration Initiative and its partners. As a result of the identification of hexabromocyclododecane (HBCD) as a CMC, it has been added to the routine monitoring program of EPA's Great Lakes Fish Monitoring and Surveillance Program. These activities provide data and information to regulatory offices within the Environmental Protection Agency for consideration and incorporation into decision making processes.

National Chemical Management

- In the United States, CMCs are regulated under a combination of multiple federal, state and local statutes and regulations, depending on the source, use and release of the respective CMC. Such work will be detailed in the forthcoming binational strategies for each CMC. The Environmental Protection Agency addresses CMCs generally through the Toxic Substances Control Act, which seeks to address the human health and environmental impacts of chemicals in industrial use through a combination of voluntary and regulatory risk management activities. The passage of The Frank R. Lautenberg Chemical Safety for the 21st Century Act on June 22, 2016, which amends the Toxic Substances Control Act, will enable the United States to better link national chemical management enhancements to those it undertakes within the Great Lakes basin.

Coordination of Inter-Agency and Federal Chemical Management Activities

- During the development of binational strategies and ensuing actions, the United States will seek to more closely align its actions at the federal levels with those at state and local levels to better support CMC-oriented actions that are specific to the Great Lakes basin.

2016

NUTRIENTS ANNEX

PROGRESS REPORT OF THE PARTIES

OVERVIEW

In some areas of the Great Lakes, excess phosphorus loadings threaten water quality and ecosystem health by contributing to harmful and nuisance algal blooms that can cause drinking water impairments, exacerbate low oxygen conditions, and drive beach closures that result in a loss of recreational opportunities. Recognizing the magnitude of the threat to Lake Erie in particular (Figure 7), the 2012 Agreement requires Canada and the United States to: 1) by 2016, revise, and if necessary, establish new phosphorus loading targets for Lake Erie, allocated by country; 2) by 2018, have in place Domestic Action Plans to achieve the Lake Erie targets.

On February 22, 2016, following a robust binational science-based process and an extensive public consultation, the United States and Canada adopted new phosphorus reduction targets for the western and central basins of Lake Erie. The Parties and multiple partner agencies are now working to develop Domestic Action Plans to meet the 2018 deadline.

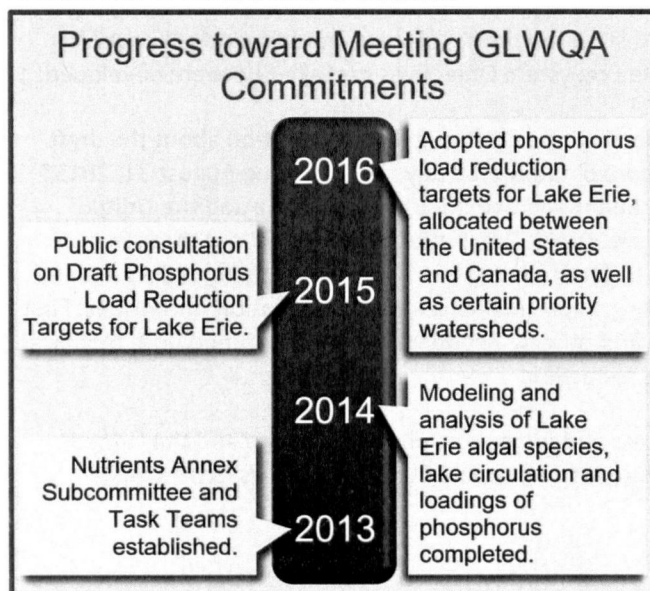
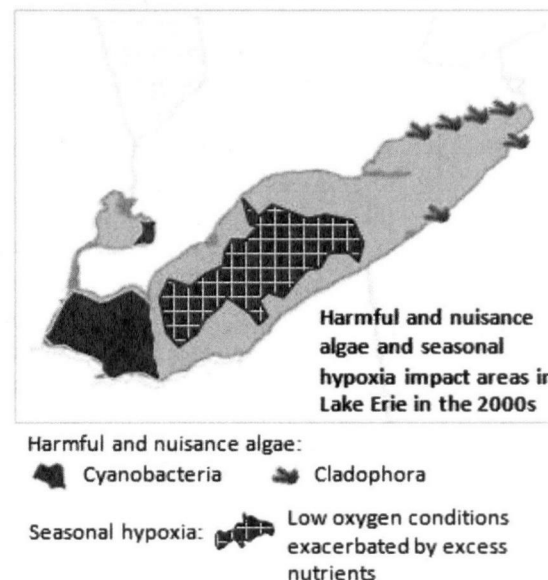
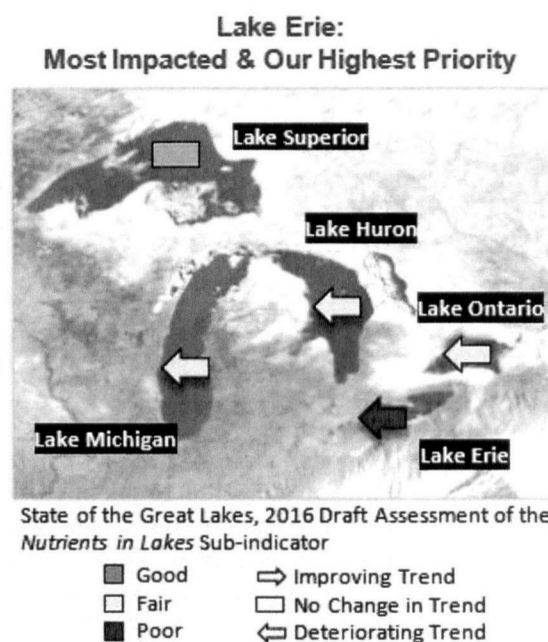


Figure 7 – Excess Phosphorus Loadings Threaten Great Lakes Water Quality and Ecosystem Health.



This Annex's implementation is supported by the Nutrients Annex Subcommittee, co-led by the United States Environmental Protection Agency and Environment and Climate Change Canada. Organizations on the Subcommittee include: **United States Environmental Protection Agency**, Great Lakes and St. Lawrence Cities Initiative, Indiana Department of Environmental Management, Michigan Department of Agriculture & Rural Development, Michigan Department of Environmental Quality, New York Department of Environmental Conservation, Ohio Department of Agriculture, Ohio Department of Natural Resources, Ohio Environmental Protection Agency, Pennsylvania Department of Environmental Protection, United States Department of Agriculture, United States Geological Survey, United States National Oceanic and Atmospheric Administration, **Environment and Climate Change Canada**, Agriculture and Agri-Food Canada, Conservation Ontario, Ontario Ministry of Agriculture Food and Rural Affairs, Ontario Ministry of Environment and Climate Change, and the Ontario Ministry of Natural Resources and Forestry.

Binational Actions Taken

The Nutrients Annex of the 2012 GLWQA established commitments for both countries to take action to manage phosphorus concentrations and loadings, and other nutrients if warranted, in the waters of the Great Lakes. The following is a summary of the binational actions taken to date for each of the Annex's five key commitments.

By 2016, develop binational substance objectives for phosphorus concentrations, loading targets, and loading allocations for Lake Erie.

- The Parties led an extensive binational effort to increase understanding of the Lake Erie algae problem in relation to the three main basins of the Lake – the western basin, the central basin and the eastern basin. Information on algal patterns and species, lake circulation, and sources and loadings of phosphorus were studied. Modeling experts from Canada and the United States used nine different computer simulation models to correlate changes in phosphorus levels with levels of algal growth. Emerging science on the bioavailability of different forms of phosphorus, particularly soluble reactive phosphorus (dissolved phosphorus that is easily taken up by algae), was considered. By comparing and contrasting the results of these models, draft phosphorus load reduction targets to achieve the Lake Ecosystem Objectives for Lake Erie were developed.
- The Parties then led extensive consultations on the draft targets. Information about the draft targets was made available online, for approximately a 60 day period ending August 31, 2015, through www.binational.net, and Environment and Climate Change Canada and the United States Environmental Protection Agency websites. The Parties also reached out through a number of binational and domestic face-to-face meetings with interested stakeholders and partners including agricultural commodity groups, municipalities, Conservation Authorities, First Nations, non-government organizations, and others. Feedback received included both technical comments on the targets as well as ideas for action.
- Following this robust science-based process and public consultation, Canada and the United States adopted the following phosphorus reduction targets for Lake Erie (based on a 2008 baseline year):

- **To minimize the extent of hypoxic zones in the waters of the central basin of Lake Erie:** a 40% reduction in total phosphorus entering the western and central basins of Lake Erie—from the United States and from Canada—to achieve an annual load of 6,000 metric tons to the central basin. This amounts to a reduction from the United States and Canada of 3,316 metric tons and 212 metric tons, respectively.
 - **To maintain algal species consistent with healthy aquatic ecosystems in the nearshore waters of the western and central basins of Lake Erie:** a 40% reduction in spring total and soluble reactive phosphorus loads from the following watersheds where algae is a localized problem: in Canada, Thames River and Leamington tributaries; and in the United States, Maumee River, River Raisin, Portage River, Toussaint Creek, Sandusky River and Huron River (Ohio).
 - **To maintain cyanobacteria biomass at levels that do not produce concentrations of toxins that pose a threat to human or ecosystem health in the waters of the western basin of Lake Erie:** a 40% reduction in spring total and soluble reactive phosphorus loads from the Maumee River in the United States.
- While the above targets for the western and central basins of Lake Erie are expected to reduce nuisance benthic algae growth (e.g., *Cladophora*) in the eastern basin, further science and analysis is underway to determine if further reductions will be necessary to address the issue in the eastern basin as well.

By 2018, develop binational phosphorus reduction strategies and domestic action plans for Lake Erie.

- The United States and Canada are working with multiple partner agencies, tribes, First Nations, Métis, and stakeholders to develop a binational phosphorous reduction strategy and Domestic Action Plans. These plans will identify the actions required to meet the agreed-to load reduction targets. Stakeholders are being engaged during the development process, and the draft plans will be available for further consultation in 2017.

Assessing, developing, and implementing programs to reduce phosphorus loadings from urban, rural, industrial and agricultural sources.

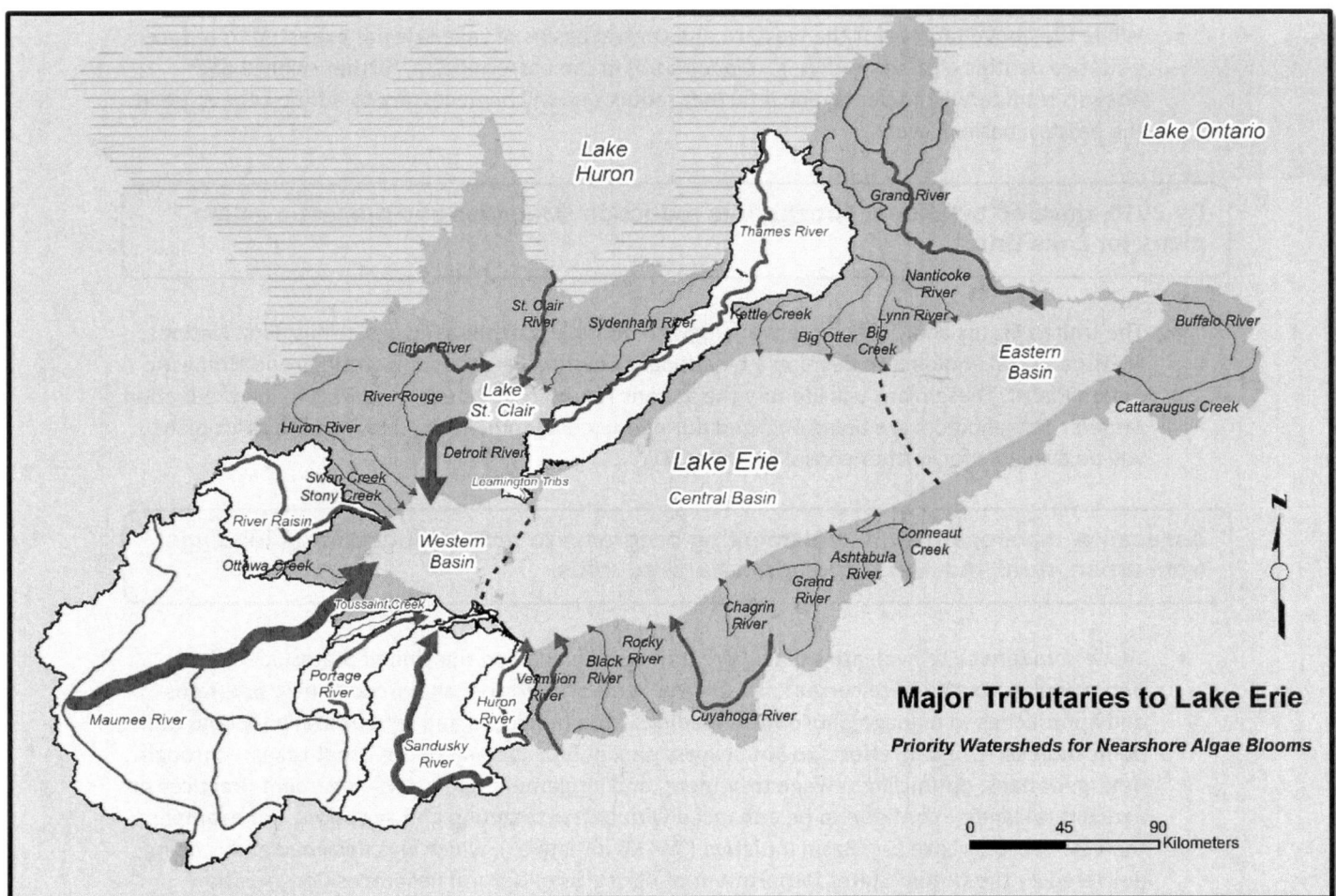
- Work is underway to evaluate existing programs in Canada and the United States, identify opportunities to maximize current phosphorus reduction efforts, and propose new programs and approaches to manage phosphorus loadings from municipal and agricultural point and non-point sources. Ongoing efforts to limit excess phosphorus loading to the Great Lakes – through detergent bans, optimizing sewage treatment, and implementing best management practices on agricultural lands – continue to be enhanced with better targeting and adoption. For example, the new Western Lake Erie Basin Initiative (“WLEB Initiative”), which was designed and is being delivered by the United States Department of Agriculture, Natural Resources Conservation Service, is based on a comprehensive assessment of conservation effects and remaining treatment needs on croplands in the western basin of Lake Erie watershed. The WLEB Initiative is designed to complement existing programs on agricultural lands in the region such as the Great Lakes Restoration Initiative, Regional Conservation Partnership Program, and general

Farm Bill efforts. Similarly, the Governments of Ontario and Canada recently launched the Great Lakes Agricultural Stewardship Initiative to provide targeted support for farmers in the Lake Erie and Lake St. Clair watersheds. For information on actions being taken in the United States and Canada to reduce phosphorus, see the "Domestic Actions Taken" section.

Identifying priority watersheds that contribute significantly to local algae development.

- The United States and Canada identified eight priority watersheds (as seen in Figure 8) – two in Canada and six in the United States – where phosphorus control is required in order to address algal blooms occurring in the nearshore waters of Lake Erie.

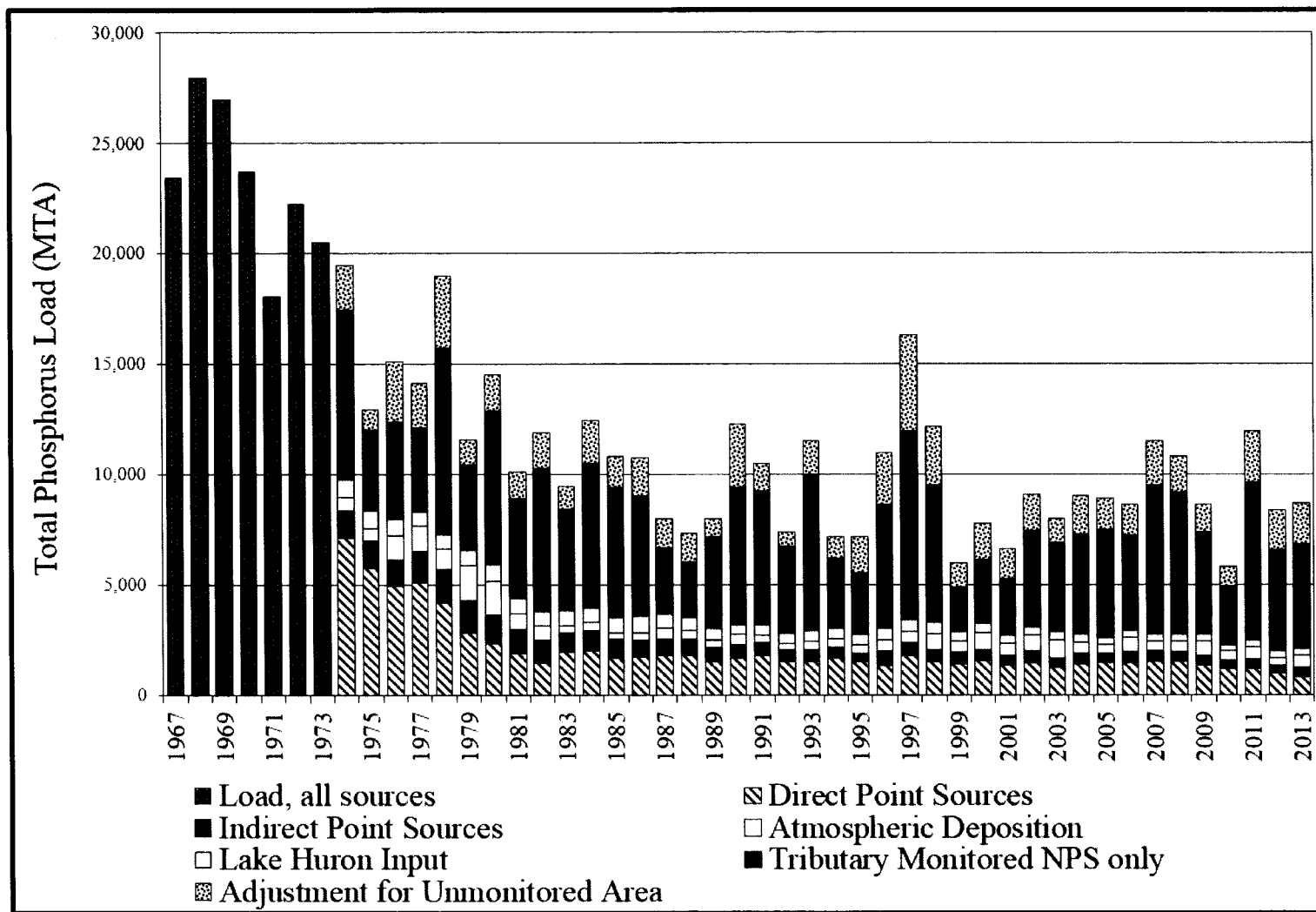
Figure 8 – Major Tributaries to Lake Erie and the Priority Watersheds for Nearshore Blooms.
Tributary Size Indicates Magnitude of Phosphorus Loading to the Lake in 2008.



Undertake and share research, monitoring and modeling necessary to establish, report on and assess the management of phosphorus and other nutrients and improve the understanding of relevant issues associated with nutrients and excessive algal blooms.

- Canada and the United States engaged many scientific experts in the development of the new phosphorus loading targets for Lake Erie, and are currently developing an approach to monitor and track progress towards the new targets. The following priorities for research, monitoring and modeling have been identified:
 - Monitoring of total phosphorus and soluble reactive phosphorus loads and harmful algal blooms and hypoxia extent and duration to evaluate effectiveness of load reduction efforts and the lake's response over time;
 - Research on factors that contribute to toxin production by harmful algal blooms; and
 - Better understanding of internal lake phosphorus loads, including factors controlling the growth of the nuisance algae *Cladophora* and improvement of ecosystem models to assist in understanding the relationship between external and internal phosphorus loads and the occurrence of algal blooms.
- Figure 9 shows historical phosphorus loadings data. Canada and the United States tracked phosphorus loads and sources on a whole-lake basis. The new targets for Lake Erie are refined to specific locations, forms of phosphorus, and time of year. Going forward, tracking and assessments related to these new targets will need refinement and appropriate data collection will be critical to the evaluation of implementation efforts and the lake's response over time.

Figure 9 – Total Phosphorus Loads to Lake Erie by Source Type, 1967 - 2013.



Source: Maccoux M.J., Dove A., Backus S.M., Dolan D.M. (In press). Total and soluble reactive phosphorus loadings to Lake Erie. Journal of Great Lakes Research [http://www.sciencedirect.com/science/article/pii/S0380133016301460].

Domestic Actions Taken

While not a comprehensive list, the following summary is intended to convey the scope and variety of nutrient management efforts by federal, state and provincial departments and agencies since the 2012 GLWQA was signed in 2013.



- In the United States, hundreds of millions of dollars are being allocated for a wide array of projects that will reduce the loading of nutrients to the Great Lakes. The United States Environmental Protection Agency (EPA) is the coordinating agency for the Great Lakes Restoration Initiative (GLRI) – the largest investment in the Great Lakes in two decades – which is implemented by an Interagency Task Force of 11 federal departments or agencies. Federal agencies and their state partners are leveraging GLRI, the Farm Bill, and many other funding resources to enhance existing programs and develop new programs aimed at reducing nutrient loads into the Great Lakes. Some examples of this are highlighted below, with a focus on Lake Erie.

More than 680 projects and \$60 million of GLRI funds were invested in the Lake Erie basin from 2010 through 2015 to reduce nutrient pollution and to support related science and monitoring work.

- Major progress is being made to: 1) accelerate nutrient reductions on the ground, 2) enhance monitoring and research efforts to better understand the effectiveness of actions taken to reduce nutrient loadings, and 3) minimize health impacts associated with harmful algal blooms. Furthermore, many recently adopted strategies, policies and legislative actions in the Great Lakes Region will have lasting impact on protecting human health and the environment from excess nutrients.

Nutrient reductions “on the ground”

- During fiscal year 2015 alone, the GLRI funded nutrient and sediment reduction projects on over 100,000 acres in targeted agricultural watersheds in the Great Lakes basin. These projects are projected to prevent over 160,000 pounds (72.5 metric tons) of phosphorus from entering the Great Lakes annually. Federal agencies and their partners also funded urban runoff projects that are anticipated to capture an average annual volume of more than 37 million gallons of untreated urban runoff per year. These projects reduce flooding, increase green space in urban areas, and return vacant properties to productive use.
- In 2015, United States Department of Agriculture (USDA) awarded \$17.5 million to a Regional Conservation Partnership Program (RCPP) in the western Lake Erie watershed. The targeted approach focuses efforts on the 855,000 acres that have been identified as the most critical areas to treat within the larger 7-million-acre watershed. The RCPP project: 1) expands access to public and private technical assistance, 2) supports new and ongoing innovative conservation practices, and 3) provides expertise for modeling and evaluating outcomes to farmers in critical sub-watersheds. The five-year multi-state project includes more than 40 collaborating public and private sector organizations with representation from Ohio, Michigan and Indiana, state and local governments, as well as non-profit entities, universities and private sector businesses, committing an additional \$28 million to the project.

- In 2016, the USDA Natural Resources Conservation Service (NRCS) launched a new funding initiative and strategy based on the findings of their special study evaluating the impacts of voluntary conservation in the western basin of Lake Erie and conservation treatment needs. The WLEB Initiative will help landowners reduce phosphorus runoff from farms by more than 640,000 pounds (290 metric tons) each year – 175,000 pounds of which is in the form of soluble phosphorus – by effectively doubling the acres under conservation in the western basin of Lake Erie watershed over the course of the three-year investment.
- GLRI funding of more than \$1.7 million was provided by NRCS in 2015 to reduce phosphorus runoff and sediment pollution in priority watersheds in the Great Lakes basin through the Great Lakes Sediment and Nutrient Reduction Program. This federal/state partnership coordinated by the Great Lakes Commission was formerly known as the Great Lakes Basin Program for Soil Erosion and Sediment Control, but became the Great Lakes Sediment and Nutrient Reduction Program in 2015 to recognize the program's increased emphasis on phosphorus reduction.
- The GLRI is also accelerating the implementation of conservation practices on Demonstration Farms in the Fox River watershed in Wisconsin and elsewhere in the region. The farms are open for annual tours where other farmers in the watershed can view the installed practices, hear farmers' opinions on the value that conservation farming practices can add to their farming operations, and ask questions. In 2016, Ohio NRCS and the Ohio Farm Bureau Federation entered into a 5-year agreement to create the Blanchard River Demonstration Farms Network. Three farms committed a total of 700 acres to be enrolled in the Network and will implement standard and innovative conservation systems to reduce the quantity of sediment and phosphorus entering the western basin of Lake Erie watershed. Data collected by the USDA Agricultural Research Service from edge-of-field water quality monitoring stations will be used to evaluate the effectiveness of these conservation systems. "Farmer field days" will be held for peer-to-peer education and technology transfer over the life of the project.
- The Ohio Environmental Protection Agency is leading implementation of the Maumee River Sediment and Nutrient Reduction Initiative – a new \$3.7 million 5-year GLRI initiative comprised of a diverse coalition of 10 public and private entities using innovative agricultural sediment reduction practices and aggressive implementation.
- The Ohio Clean Lakes Initiative appropriated more than \$3.55 million for the installation of best management practices (BMPs) to reduce nutrient runoff in the western basin of Lake Erie watershed. State and local partners worked with more than 350 farmers to implement BMPs on more than 40,000 acres.
- Since 2010, the Ohio Environmental Protection Agency has awarded more than \$292 million in low-interest and interest-free loans from the Water Pollution Control Loan Fund for 138 projects in the western basin of Lake Erie watershed. These projects help local communities develop and implement long-term control plans to reduce overflows of nutrient-rich sewage into streams and lakes following heavy storms and snow melt.
- The Michigan Department of Environmental Quality has been working with the Detroit Water and Sewerage Department to proactively take measures to reduce loadings of Total Phosphorus from the Detroit plant, through lower permitted effluent limits and strategies to minimize untreated discharges from combined sewer systems. Optimization of the plant in 2013 has

reduced the average annual loading of Total Phosphorus to Lake Erie by approximately 65 Metric Tons.

- Indiana is working with landowners to help improve the water quality of streams and inland rivers, and ultimately Lake Erie, by partnering on several projects which will result in significant measurable load reductions in nutrients and sediment. A summary of the progress being made in Indiana's portion of the western basin of Lake Erie can be found at the Indiana State Department of Agriculture website (<http://www.in.gov/isda/3261.htm>).
- Pennsylvania is working with Lake Erie MS4 (municipal separate storm sewer system) municipalities to plan for future stormwater infrastructure needs, and with grape farmers to improve environmental and economic sustainability of their agricultural operations through the Pennsylvania Vested in Environmental Sustainability Program.
- The New York State Department of Environmental Conservation (DEC) is forming the Lake Erie Watershed Protection Alliance, comprised of three counties and numerous municipalities within the Lake Erie watershed that will work cooperatively to monitor Lake Erie tributaries and work locally to further reduce sources of nutrients and pathogens. The DEC is also partnering with the State's Department of Agriculture and Markets and the Genesee River Watershed Coalition of Conservation Districts to implement a strategy to promote and track the effectiveness of nutrient reduction best management practices among farms in the Genesee River watershed (part of the Lake Ontario Watershed), a GLRI Priority Watershed for Nutrient Reduction.

Enhanced monitoring and forecasting tools

- GLRI-funded research led by the National Oceanic and Atmospheric Administration's Great Lakes Environmental Research Laboratory, in collaboration with partners from the University of Michigan's Cooperative Institute for Limnology and Ecosystems Research, is investigating the impact of land use changes on algal bloom development in the western basin of Lake Erie and in Lake Huron's Saginaw Bay. The Great Lakes Environmental Research Laboratory combines remote sensing, monitoring, and modeling to produce weekly forecasts of *Microcystin* bloom concentration and transport in Lake Erie, which are distributed to regional stakeholders. National Oceanic and Atmospheric Administration researchers, with their partners at Heidelberg University, have also initiated early season projections of the seasonal harmful algal bloom severity in western Lake Erie.
- During fiscal year 2015, GLRI partners established a network of four real-time continuous observing buoys to track detailed water quality conditions to support modeling, forecasting, and public warnings of harmful algal bloom conditions throughout western Lake Erie. The observing buoys are capable of tracking water quality and bloom conditions and measuring soluble phosphorus concentrations at hourly intervals. During the 2015 bloom season, these buoys collected over 7,000 in-lake nutrient and water quality measurements, providing unprecedented spatial and temporal details of internal lake dynamics and bloom development. In addition to providing real-time tracking of harmful algal bloom conditions for water intake managers and recreational users, the observing data will be used to improve ongoing forecasting efforts covering a range of spatial and temporal scales including seasonal harmful algal bloom forecasts, five-day forecasts, and vertical distribution forecasts.

- After the “do not drink” advisory issued in Toledo, Ohio in August 2014, Ohio passed legislation in July 2015 to address harmful algal blooms and algal toxins at public water supplies. New rules were then finalized in 2016 that established a drinking water action level for microcystins, outlined monitoring requirements for microcystins and cyanobacteria screening, and established public notification, reporting, treatment technique and laboratory certification requirements. The state agencies in Ohio also worked together to revise the State’s Harmful Algal Bloom Response Strategy for Recreational Waters where harmful algal blooms exist or are suspected. Ohio is one of the first states to establish formal rules for issuing advisories when algal toxins are present at or above threshold levels.
- In coordination with the Pennsylvania Lake Erie Harmful Algae Bloom Task Force, the Pennsylvania Department of Environmental Protection began a strategic partnership with the Regional Science Consortium at Presque Isle to complete comprehensive monitoring of Pennsylvania Lake Erie beaches and public areas for the presence of harmful algal bloom conditions throughout the 2016 season.
- United States Geological Survey scientists collect water-flow and water-quality data from 24 tributaries to the Great Lakes to measure natural and human-caused sources of nutrients and sediment to the lakes. The Great Lakes National Monitoring Network continues to be enhanced through the use of automated samplers and water quality multi-sensor probes, to provide better baseline information on nutrient loads and demonstrate the ability to reduce monitoring costs through the use of real-time sensors.
- The National Oceanic and Atmospheric Administration National Weather Service is leveraging GLRI funding to develop and implement runoff risk reduction tools aimed at enhancing short-term (*i.e.*, the next 10 days) nutrient application management. Incorporated into their daily routines, this tool will alert applicators of future unsuitable conditions caused by rainfall or snowmelt that could result in undesired transport of recently applied manure and fertilizer from their fields into nearby water bodies.
- Federal agencies and partners are also working to expand edge of field (EOF) monitoring and research, which measures the amount of nutrients and sediment in water runoff from agricultural fields to compare the improvements under different conservation systems. This research is critical to evaluating the effectiveness of agricultural best management practices. The United States Geological Survey is leading a GLRI-funded effort with NRCS and other partners to conduct EOF monitoring on 22 farm sites in the Maumee River, Fox River, Saginaw River and Genesee River watersheds. These watersheds were selected because of the high density of agricultural land use and their ecosystem impairments.
- Also in partnership with NRCS, the United States Department of Agriculture’s Agricultural Research Services (ARS), has an extensive network of 42 EOF study sites in Ohio. The number, quality and spatial extent of this ARS managed effort is unprecedented and science from this work, particularly in conjunction with watershed assessment under NRCS’s Conservation Assessment Effects Program, has already been key to assessing nutrient losses and informing conservation strategies in the WLEB.

New Nutrient Management Strategies, Policies and Legislative Actions

- In June 2015 Governor Rick Snyder of Michigan, Premier Kathleen Wynne of Ontario and Lieutenant Governor Mary Taylor of Ohio signed the Western Basin of Lake Erie Collaborative Agreement which establishes a collaborative initiative that will use adaptive management to achieve a recommended 40% total load reduction in the amount of total phosphorus and soluble reactive phosphorus entering the western basin of Lake Erie by the year 2025 with an aspirational interim goal of a 20% reduction by 2020. Each state and province committed to developing, with stakeholder involvement, a plan outlining their proposed actions and time lines toward achieving the phosphorus reduction goal. Michigan and Ohio released draft implementation plans in response to this commitment in 2015 and 2016, respectively.
- In May 2014, Ohio Governor John R. Kasich signed into law Senate Bill 150. The bill requires fertilizer applicators to undergo education and certification by the Ohio Department of Agriculture (ODA); encourages producers to adopt nutrient management plans; and allows ODA to better track the sales and distribution of fertilizer. In April 2015, the Governor signed Senate Bill 1, legislation to protect Lake Erie and Ohio's water quality. Highlights include: restrictions on fertilizer and manure application on frozen, snow-covered or saturated ground in the western basin of Lake Erie watershed; prohibition of open lake disposal of dredge material by 2020; and additional phosphorus monitoring at wastewater treatment facilities.
- Minnesota's landmark buffer law will establish new perennial vegetation buffers along rivers, streams, lakes, public ditches and some wetlands. Buffers protect water resources by helping filter out phosphorus, nitrogen and sediment. Governor Mark Dayton championed the buffer initiative legislation in the 2015 and 2016 sessions. Studies by the Minnesota Pollution Control Agency show that buffers are critical to protecting and restoring water quality and aquatic habitat.
- In January 2010, New York's Phosphorous Runoff Act went into effect, designed to reduce water pollution caused by excess phosphorus running off lawns into New York waters by restricting sales of all non-agricultural fertilizer to concentrations less than 0.67% phosphate, with certain exceptions. Since 2014-2015, the State Attorney General has reached settlements on violations of the law by major retailers at 12 stores in the Lake Erie/Niagara River watershed.
- In June 2014, Congress reauthorized the Harmful Algal Bloom and Hypoxia Research and Control Act (HABHRCA) by passing the Harmful Algal Bloom and Hypoxia Research and Control Amendments Act of 2014 (HABHRCA 2014, P.L. 113-124). The reauthorization of HABHRCA acknowledged concerns related to harmful algal blooms (HABs) and hypoxia, extended the scope of the legislation to include freshwater HABs and hypoxia, and recognized the need for further coordinated action across the federal sector to address these issues. Additionally, the legislation called for federal agencies to provide integrated assessments on the causes and consequences of and approaches to reducing HABs and hypoxia nationally, with particular emphasis on the Great Lakes. Finally, the reauthorization included a specific focus on the needs of stakeholders, requiring that federal agencies engage with stakeholders around the country.
- On August 7th, 2015, the President signed H.R. 212 (Drinking Water Protection Act) which directs EPA to develop and submit a strategic plan for assessing and managing risks associated with algal toxins in drinking water provided by public water systems. The resulting Algal Toxin Risk Assessment and Management Strategic Plan for Drinking Water, released in November

2015, includes steps and timelines to assess: algal toxins and their human health effects, health advisories, factors likely to cause HABs, treatment options, analytical methods, frequency of monitoring, treatment options, and source water protection practices.

- Currently there are no U.S. federal water quality criteria, or regulations for cyanobacteria or cyanotoxins in drinking water under the Safe Drinking Water Act (SDWA) or in ambient waters under the Clean Water Act (CWA). However, under the SDWA, EPA may publish Health Advisories for contaminants that are not subject to any national primary drinking water regulation. EPA developed Health Advisories for the cyanobacterial toxins microcystins and cylindrospermopsin in 2015, and is currently developing Ambient Water Quality Criteria for cyanotoxins for the protection of recreational activities in freshwater systems.
- The Ohio Environmental Protection Agency is developing Nutrient Water Quality Standards targeting phosphorus and nitrogen in response to U.S. EPA's national nutrient criteria recommendations and the Clean Water Act. In 2013, the Ohio Environmental Protection Agency asked for public comments from various stakeholder groups. A nutrient technical advisory group will advise Ohio Environmental Protection Agency as it moves forward with the next steps in developing nutrient standards.
- As part of Indiana's Nutrient Reduction Strategy, in 2013, the Indiana Conservation Partnership began using a common Load Reduction model to track and report the impact of installed conservation practices on water quality. Nutrient and sediment load reductions are estimated from a variety of state and federally funded programs. Indiana is the only state in the country to adopt a common model among so many partners to estimate conservation impact on a statewide scale.
- Following an extensive engagement process, the Michigan Department of Environmental Quality's Office of the Great Lakes recently finalized a new Water Strategy built around a 30-year vision for ensuring that Michigan's water resources support healthy ecosystems, residents, communities and economies. A key recommendation in the strategy is to achieve a 40% reduction to phosphorus in the western basin of Lake Erie watershed.



- Canada and Ontario are taking action under the Canada-Ontario Agreement on Great Lakes Water Quality and Ecosystem Health, 2014, to reduce phosphorus loads to Lake Erie through urban, agricultural, rural and industrial or commercial point and non-point source initiatives including ongoing infrastructure and agricultural stewardship programs. To further improve the effectiveness of current and future phosphorus reduction actions in Lake Erie, Canada and Ontario, along with their partners and stakeholders, are working to review and where necessary implement changes to the existing program, policy and legislative phosphorus management frameworks.
- Canada's Great Lakes Nutrient Initiative (2012-2016) enhanced Environment and Climate Canada funding to support the critical science and policy development needed to support the establishment of new phosphorus reduction targets for Lake Erie. Initiative activities included:
 - Enhanced water quality monitoring at key locations in the Lake Erie basin – including the Thames River, the Sydenham River, the Detroit River and the Grand River – in order to

- measure phosphorus concentrations and loads from the Canadian portion of the Lake Erie basin;
 - New modeling and research to enhance understanding of the factors contributing to the reoccurrence of large scale outbreaks of toxic and nuisance algae in Lake Erie;
 - An assessment of current Canadian best practices and policy options for reducing loadings of phosphorus to Lake Erie in order to achieve targets;
 - An assessment of socio-economic costs of algal blooms in Lake Erie;
 - The development of inventories of phosphorus management programs;
 - Cost-benefit modeling of phosphorus management in the Grand River basin; and
 - An assessment of future trends and demographics in urban and agriculture landscapes in the Lake Erie basin.
- Canada's 2016 Federal Budget announced \$3.1 million in 2016 to 2017, to Environment and Climate Change Canada, to continue to improve nearshore water and ecosystem health, by reducing phosphorus and the resulting algae in Lake Erie. With these resources, and building on the work accomplished under the Great Lakes Nutrient Initiative, the focus will shift from setting phosphorus targets to achieving them, including developing a domestic action plan in collaboration with Ontario and other partners, and monitoring and reporting on progress.
 - Canada's 2016 Federal Budget also announced a five-year, \$5.0 billion investment in water, wastewater and green infrastructure projects across Canada. This includes the \$2 billion Clean Water and Wastewater Fund (CWWF), of which \$569,642,062 has been allocated for water and wastewater projects in the Province of Ontario. The CWWF, and existing programs such as the New Building Canada Fund – Provincial-Territorial Infrastructure Component (NBCF-PTIC), will address phosphorus loads from municipal wastewater, as well as other priorities. Provinces and territories, in consultation with municipalities, are responsible for identifying projects to be funded through the CWWF and the NBCF-PTIC, including projects for reducing phosphorous loads in the Great Lakes.
 - Canada continues to invest in research that improves our understanding of phosphorus uptake and movement, and develops best management practices and technologies to improve crop nutrient use efficiency and reduce phosphorus losses from agricultural production to the Great Lakes. Over the last three years, projects funded by Agriculture and Agri-Food Canada have investigated the nature of losses of phosphorus through subsurface tile drains, improved field and regional indicators of risk of phosphorus loss to water, developed tests to indicate availability of phosphorus from different manures and soils to crops and losses by water, and characterized the Canadian basin of Lake Erie by agricultural production systems (*i.e.*, cropping, livestock, horticulture). Research on Lake Erie is also a priority under the science sector strategy for *Agro-ecosystem Productivity and Health*, which is one of the sector strategies guiding future Agriculture and Agri-Food Canada investment in research.
 - Canada has also launched discussions with provinces, towards renewing Canada's federal-provincial agricultural policy framework, called Growing Forward. Discussions on priorities for a renewed Growing Forward agreement will take into consideration agricultural contributions to phosphorus loadings.
 - As part of the Growing Forward agreement, the governments of Ontario and Canada launched the Great Lakes Agricultural Stewardship Initiative (<http://www.ontariosoilcrop.org/oscia->

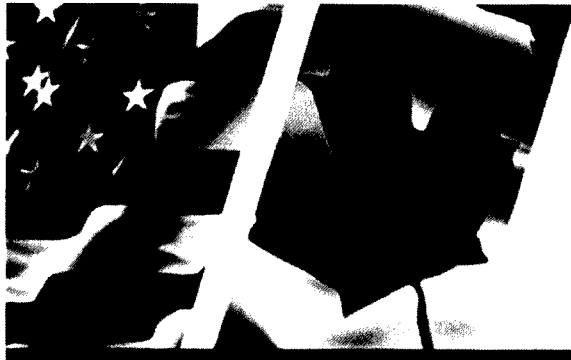
programs/glasi/), to provide \$4 million annually, over 2015 to 2018, in targeted support for farmers in the Lake Erie and Lake St. Clair watersheds, and in Lake Huron's southeast shores watershed. Producers and their advisors will identify ways producers can improve soil health, reduce run-off, modify equipment to address risks related to manure application, create soil erosion control structures, grow cover crops, manage crop residue, and build buffer and shelter strips. As part of this initiative:

- Sub-watersheds requiring focus and attention have been selected where a systems approach to best management practices will be demonstrated, verified, measured and modeled to determine their reduction of non-point phosphorous loading.
 - Education and outreach projects are underway to promote greater understanding of Great Lakes water quality and to promote the uptake of actions to improve it.
 - The Farmland Health Checkup, a proactive whole farm environmental evaluation was created. The Farmland Health Checkup identifies site specific actions to manage phosphorus and soil health by teaming farmers with trained agronomic and water quality experts. Cost-share funding is available for implementing identified actions that reduce phosphorus loss and improve soil health.
- Agriculture and Agri-Food Canada and the Ontario Ministry of Agriculture, Food and Rural Affairs funded the Water Resource Adaptation and Management Initiative (WRAMI) and the Water Adaption Management and Quality Initiative (WAMQI) for \$3 Million. The WRAMI initiative in 2013 (17 projects) and the expanded WAMQI in 2014 (28 projects) included projects to help Ontario farmers better manage nutrients and minimize off-site impacts of nutrients on surface and ground water quality. Demonstration of technologies such as closed system water recycling, precision manure application, low erosion and cover crop planting were all part of this initiative.
- Ontario's Great Lakes Protection Act, 2015, which received Royal Assent on November 3, 2015, reflects the goals and principles of Ontario's Great Lakes Strategy and enshrines it in law, setting out detailed requirements for strategy contents, reporting and periodic review (<https://www.ontario.ca/page/protecting-great-lakes>). The Act is designed to help address the significant environmental challenges facing the Great Lakes and St. Lawrence River basin, including the changing climate. One of the initial priorities identified under the Act for immediate action is reducing harmful algal blooms by committing to establishing at least one target within two years to support the reduction of algal blooms; and the Act will enable geographically-focused initiatives as a tool for developing and implementing policies to address priority issues, including reducing excessive algae, in a specific location.
- Ontario government researchers are adding to the understanding of harmful algal blooms and nuisance algae by monitoring nearshore water quality at 17 drinking water intake sites in the Great Lakes, including five locations in Lake Erie. The Government of Ontario also monitors 70 sites in nearshore areas of the Great Lakes to track long-term trends in Great Lakes water quality. These long-term data sets, together with special studies in the lakes and their tributaries, advance our understanding of nearshore responses to climate change and other stressors, including changes in nutrient loading.
- In 2013, the Government of Ontario launched the Multi-Watershed Nutrient Study. The seven-year study will examine the management of agricultural land and the extent of nutrient runoff in

11 agricultural watersheds in the basins of Lakes Erie, Ontario and Huron. This will be an ongoing study to determine the role agriculture can play in resolving a very complex issue. Comparative data from previous studies will be used to track changing climate conditions, to develop a “then-and-now” analysis and to model future scenarios.

- The Ministry of Environment and Climate Change, together with the Ministry of Agriculture, Food and Rural Affairs, ensure the requirements of the Nutrient Management Act and regulations are met by farmers through approval of nutrient management plans and strategies that detail the source, rate, time and placement of nutrients for crop growth. Ontario continues to provide training, examination and certification of professional nutrient management planners which work with farmers to apply environmentally responsible nutrient use. Resources detailing better management practices and regulatory requirements have been updated to be more interactive and easier to use.
- In 2016, the Government of Ontario increased targeted engagement with the agricultural community to encourage organizations and industry to take the lead in addressing the phosphorus issue. A working group, composed of farmers, conservation authorities, agri-business and farm organizations, was convened to discuss and analyze key priorities to identify and implement additional actions to improve water quality. Topics included timing of application of nutrients and expanded use of cover crops. Workgroup members have initiated pilot projects to support further uptake of actions by farmers such as: in-field demonstrations; education workshops; best management practices toolkits; performance standards coaches for nutrient management; and research to support continuous improvement.
- The Government of Ontario worked with the Ontario Greenhouse Alliance on an overall strategy to reduce phosphorous discharges into the Leamington tributaries – a priority watershed under the 2012 GLWQA due to the presence of nearshore algae blooms. In January 2015, as part of this strategy the Government of Ontario instituted new regulations, under the Nutrient Management Act, to provide an effective option whereby nutrients that can no longer be used in the greenhouse, may be applied to field crops. In the spring of 2016, growers were offered additional information and cost-share support to help them achieve compliance approval for surface water discharges by March 31, 2017.
- 4Rs Nutrient Stewardship is an internationally recognized approach based on core scientific principles of applying the right source of plant nutrition, at the right rate, at the right time, and in the right place to improve nutrient use efficiency to reduce any potential nutrient loss into the environment. As a result of the partnership of the Ontario Ministry of Agriculture, Food and Rural Affairs, Fertilizer Canada, and the Ontario Agri Business Association, Ontario is piloting 4R initiatives ahead of broader implementation across the Lake Erie basin and has successfully:
 - Implemented 20 4R Demonstration Farms;
 - Reached more than 115 Ontario growers through 4R Nutrient Stewardship Workshops;
 - Enrolled 21 agri-retailers in the Ontario Agri Business Association’s voluntary 4R Designated Acres pilot program; and
 - Launched the Ontario Certified Crop Advisor 4R Nutrient Management Specialty Certification; 65 of Ontario’s Certified Crop Advisors are registered to write the certification exam in August 2016.

- Between 2013 and 2016, Ontario Ministry of Agriculture, Food and Rural Affairs' research programs, University of Guelph Partnership and New Directions, provided approximately \$3.4 million in direct project operating funding to 25 research projects that targeted improvement of agri-food sector's water quality and nutrient management efficiency in the Great Lakes watershed. Another \$1 million since 2013 in 21 applied field projects verified and demonstrated best management practices to support the reduction of phosphorus to Lake Erie. The objectives of these research projects include development and evaluation of wastewater treatment technologies/best management practices, improvement of nitrogen use efficiency in crops, understanding phosphorus dynamics and non-point sources in the field, groundwater quality and soil health. The major research collaborators/partners include primary producers, food processors, Ontario universities and colleges, conservation authorities and non-governmental organizations.



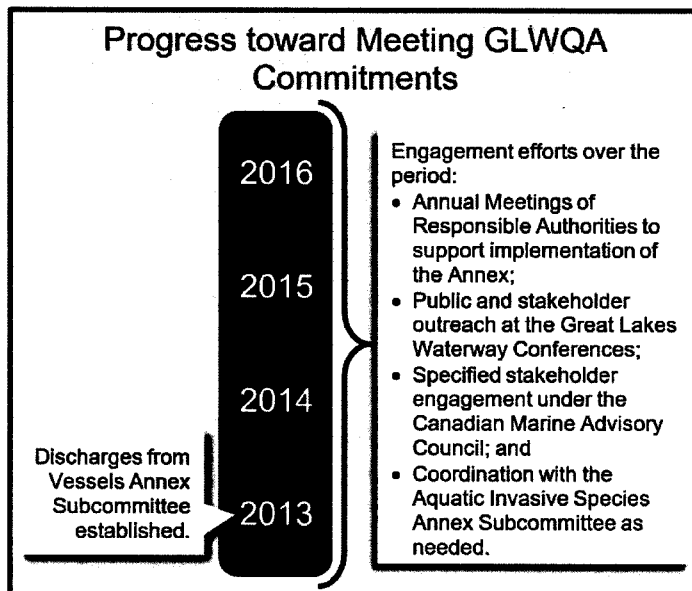
DISCHARGES FROM VESSELS ANNEX

2016

PROGRESS REPORT OF THE PARTIES

OVERVIEW

The Great Lakes and St. Lawrence Seaway System is a binational trade route that supports tens of thousands of jobs on both sides of the border and serves as a critical transportation corridor for commodities such as iron ore, coal, minerals and grain. Canada and the United States recognize the environmental and economic importance of this system and ensuring it is safeguarded. The Discharges from Vessels Annex of the 2012 GLWQA commits the responsible authorities in Canada and the United States (Transport Canada, Fisheries and Oceans Canada, the Canadian Coast Guard, the United States Coast Guard, and the United States Environmental Protection Agency) to prevent and control vessel discharges that are harmful to the waters of the Great Lakes, including: Oil and Hazardous Polluting Substances; Garbage; Wastewater and Sewage; Biofouling; Antifouling Systems; and Ballast Water.



Under the 1987 GLWQA, biennial reports to the International Joint Commission from the responsible Canadian and the United States agencies (last submitted in 2012) consistently indicated that potential discharges of oil and hazardous substances, garbage, wastewater, ballast water and sewage from vessels are well-regulated and that sufficient reception facilities are available to receive discharges ashore. This continues to be the case as enforcement of Canadian and United States domestic regulatory regimes and applicable international conventions has reduced the risk of discharges of concern from vessels. Canada and the United States are committed to the continued prevention and reduction of threats to the waters of the Great Lakes from all vessel discharges.

This Annex's implementation is supported by the Discharges from Vessels Annex Subcommittee, co-led by Transport Canada and the United States Coast Guard. Organizations on the Subcommittee include:

Transport Canada, Canadian Coast Guard, Fisheries and Oceans Canada, Ontario Ministry of Transportation, Canadian Ship Owners Association, Shipping Federation of Canada, **United States Coast Guard**, Indiana Department of Environmental Management, United States Environmental Protection Agency, United States Maritime Administration, Wisconsin Department of Natural Resources, and the Lake Carriers Association.

Binational Actions Taken

Preventing the discharge of Oil and Hazardous Polluting Substances from vessels.

- Transport Canada and the United States Coast Guard have a compatible and effective port and flag state regulatory regime in place to prevent the discharge of oil or hazardous substances on the Great Lakes from vessels and maritime transportation-related facilities that transfer oil or hazardous substances in bulk. The countries' port state control initiatives are risk-based vessel examination programs focused on foreign-flag vessels (non-Party) that operate in their respective waters to ensure compliance with international conventions and the Parties' laws and regulations. The Parties' flag-state programs ensure comparable compliance by the Canadian or United States flag fleets.
- In response to the possibility of the maritime transportation of crude or other heavy oils on the Great Lakes, Canada and the United States created a working group on Maritime Transportation of Hydrocarbons and their by-products. This multi-agency group, chaired by the Transport Canada and the United States Coast Guard, serves as a binational forum to facilitate discussions regarding maritime shipments of hydrocarbons and their by-products (defined initially as crude oil and associated bulk liquids) and address any concerns that may arise in a coherent and consistent manner. The initial focus of this work is on freshwater, including the Great Lakes and its tributaries, and the St. Lawrence River and Seaway. A phased workplan has been developed and will focus on areas of mutual interest in preparedness, response, liability, and compensation.

Addressing the discharge of Garbage from vessels.

- The illegal discharge of Garbage from commercial vessels in the Great Lakes continues to be a rare event. For the Great Lakes and the coasts, the majority of marine debris entering the water comes from shore-side sources.
- No violations of the International Convention for the Prevention of Pollution from Ships Annex V (MARPOL V) or other garbage-related incidents were detected or reported between 2013 and 2016.

Ensuring adequate reception facilities for Garbage from vessels.

- There are sufficient and adequate MARPOL V reception facilities on the Great Lakes. There has not been a validated report of an inadequate reception facility on the Great Lakes since 2006.

Addressing the discharge of Wastewater and Sewage from vessels.

- Several Great Lakes states have established “no discharge zones” of sewage in their respective waters in accordance with the United States Clean Water Act. Since Marine Sanitation Devices on most vessels are designed for continuous operations, it has been reported that some vessels with no or insufficient holding tanks have been forced to divert untreated sewage or treated effluent to ballast tanks to remain in compliance. Both Canada and the United States are in agreement that ballast tanks are not an appropriate place to store sewage – treated or untreated.

Preventing harm from vessels’ Antifouling Systems.

- Both Canada and the United States have regulations or policies in place implementing the International Convention on the Control of Harmful Anti-Fouling Systems on Ships (IAFS), which ensures that anti-fouling paint applied to vessels is free of tributyltin. Anti-fouling paint containing tributyltin is not available for sale on either side of the border. Both countries issue IAFS certificates to their flag state vessels and incorporate the IAFS in their respective Port State Control enforcement programs.

Addressing the discharge of Aquatic Invasive Species in the Ballast Water from vessels.

- The risk of the introduction of aquatic invasive species (AIS) to the Great Lakes via ballast water discharges from vessels arriving from outside of Canada’s Exclusive Economic Zones¹ has been substantially reduced. Because of compatible ballast water exchange regulations between Canada and the United States and stringent binational enforcement, no new AIS attributable to the ballast water of these ships has been reported in the Great Lakes since 2006. Since that date, the Ballast Water Working Group² has examined 100% of these vessels. During these ballast management exams, 100% of the vessels’ ballast tanks are examined to ensure that tanks have been fully exchanged or sufficiently flushed with sea water. Vessels that had not exchanged their ballast water or flushed their ballast tanks were required to either retain the ballast water and residuals onboard, treat the ballast water in an environmentally sound and approved manner, or return to sea to conduct a ballast water exchange. Vessels that were unable to exchange their ballast water or residuals and that were required to retain them onboard received a verification exam during their outbound transit, prior to exiting the Seaway.

¹ In relation to the Great Lakes, the Exclusive Economic Zones stretches 200 nautical miles from Atlantic coast and includes the Gulf of St. Lawrence.

² The Ballast Water Working Group is comprised of representatives from the United States Coast Guard, the U.S. Saint Lawrence Seaway Development Corporation, Transport Canada, and the Canadian St. Lawrence Seaway Management Corporation. Created in 2006, the group’s mandate is to develop, enhance, and coordinate binational compliance and enforcement efforts to reduce the introduction of aquatic invasive species by transoceanic ships via ballast water and residuals.

The Ballast Water Working Group verification efforts indicated that there was no non-compliant ballast water discharged in the Great Lakes. The Ballast Water Working Group annual reports for the past three years can be accessed at:

- http://www.greatlakes-seaway.com/en/pdf/2014_BW_Rpt_EN.pdf
- http://www.greatlakes-seaway.com/en/pdf/2013_BW_Rpt_EN.pdf
- http://www.greatlakes-seaway.com/en/pdf/2012_BW_Rpt_EN.pdf
- Significant work is underway to move the current exchange-based programs to binationally compatible technology-based regimes that will require treatment of all ballast water to a common discharge standard and address the risk of spreading organisms. As agreed in the 2012 GLWQA, both Parties are taking into account, as appropriate, the standards set forth in the *International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004* (the "BWM Convention") and its associated guidance. Canada has acceded to the BWM Convention while the United States Environmental Protection Agency, the United States Coast Guard, and the American Great Lakes States have established requirements under the *National Invasive Species Act* and the *Clean Water Act*. While there are differences between these approaches, the United States and Canada continue to work closely together – including bilaterally through annual meetings of the responsible authorities outlined in the Discharges from Vessels Annex and at the International Maritime Organization – towards maintaining compatible, fair, practicable and environmentally protective ballast water requirements in both countries.

Preventing the discharge of Biofouling from vessels.

- Both Canada and the United States have participated in the development of the International Maritime Organization's 2011 Guidelines for the Control and Management of Ships' Biofouling to Minimize the Transfer of Invasive Aquatic Species.

Domestic Actions Taken

Ballast Water



CANADA

- Were the BWM Convention to enter into force now, technical and regional compatibility factors would pose challenges to ships operating primarily on the Great Lakes-St. Lawrence Seaway system. As this Convention has not yet entered into force, Canada will continue to monitor these challenges and is considering options in case these challenges persist upon the Convention's entry into force. Canada remains committed to the Convention and will continue to work with the United States and other stakeholders towards compatible, fair, practicable and environmentally protective Great Lakes requirements meeting Canada's international obligations.
- Canada also continues to actively conduct ballast water research applicable to the Great Lakes. Results of a recent national risk assessment indicate that the ballast water transported by Great Lakes ships poses a high risk for spreading aquatic invasive species between ports in Canada and the United States when compared with the ballast water transported by international vessels

(which are subject to regulations in both countries focused on lowering the risk of introductions from foreign ports). The following are ballast water research studies were undertaken by Canada since 2012:

- Combining ballast water exchange and treatment to maximize prevention of species introductions to freshwater ecosystems
(<http://pubs.acs.org/doi/abs/10.1021/acs.est.5b01795>)
- Are the Great Lakes at risk of new fish invasions from trans-Atlantic shipping?
(<http://www.sciencedirect.com/science/article/pii/S0380133015001422>)
- Relative Invasion Risk for Plankton across Marine and Freshwater Systems: Examining Efficacy of Proposed International Ballast Water Discharge Standards
(<http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0118267>)
- National risk assessment for introduction of aquatic nonindigenous species to Canada by ballast water (http://www.dfo-mpo.gc.ca/csas-sccs/Publications/ResDocs-DocRech/2013/2013_128-eng.html)
- Evaluating efficacy of a ballast water filtration system for reducing spread of aquatic species in freshwater ecosystems
(http://www.reabic.net/journals/mbi/2014/3/MBI_2014_Briski_et al.pdf)
- Domestic ships as a potential pathway of nonindigenous species from the St. Lawrence River to the Great Lakes (<http://link.springer.com/article/10.1007%2Fs10530-013-0537-5>)
- Physical dispersion and dilution of ballast water discharge in the St. Clair River: Implications for biological invasions
(<http://onlinelibrary.wiley.com/doi/10.1002/wrcr.20201/abstract>)
- Taxon- and vector-specific variation in species richness and abundance during the transport stage of biological invasions
(http://www.aslo.org/lo/toc/vol_58/issue_4/1361.html)
- A multi-dimensional approach to invasive species prevention
(<http://pubs.acs.org/doi/abs/10.1021/es3029445>)
- Role of domestic shipping in the introduction or secondary spread of nonindigenous species: biological invasions within the Laurentian Great Lakes
(<http://onlinelibrary.wiley.com/doi/10.1111/j.1365-2664.2012.02186.x/full>)
- Efficacy of NaCl brine for treatment of ballast water against freshwater invasions
(<http://www.sciencedirect.com/science/article/pii/S0380133011002176>)
- Risk assessment for ship-mediated introductions of aquatic nonindigenous species to the Great Lakes and freshwater St. Lawrence River (http://www.dfo-mpo.gc.ca/csas-sccs/Publications/ResDocs-DocRech/2011/2011_104-eng.html)
- "In consultation with stakeholders, and in accordance with the GLWQA, Canada has reviewed the efficacy of shipboard technologies for ballast water and the feasibility of fitting them onboard Great Lakes ships. A report of this process is titled Transactions on Ballast Water Treatment Systems for the Great Lakes-St. Lawrence Seaway System and is available online at:
[https://www.tc.gc.ca/media/documents/marinesafety/Transactions for BWTS on the Great Lakes - Transport Canada.pdf](https://www.tc.gc.ca/media/documents/marinesafety/Transactions_for_BWTS_on_the_Great_Lakes_-_Transport_Canada.pdf)"

Oil and Hazardous Substances



- On August 28, 2015, the marine archaeological group, Cleveland Underwater Explorers (CLUE), discovered the barge ARGO (which had sunk during a storm in 1937 while carrying approximately 200,000 gallons of petroleum product – believed to be benzol and/or a light petroleum variant) approximately nine miles east of Kelleys Island and two miles south of the international border with Canada in approximately 13 meters of water. On September 8, 2015, CLUE notified the United States Coast Guard of the discovery. The GLEC was notified of a suspected minor discharge of product from the barge in accordance with Article 6 (a) of the 2012 GLWQA, and soon after, a Unified Command consisting of the Ohio Environmental Protection Agency and the United States Coast Guard was established. Assistance was provided by the United States Environmental Protection Agency, Ohio Department of Natural Resources, National Oceanic and Atmospheric Administration, Ohio Emergency Management Agency, Canadian Coast Guard, and Environment and Climate Change Canada. The Unified Command oversaw the survey of the tank barge and the safe removal of several thousand gallons of a benzene-type hazardous substance from two of the barge's tanks.

Ballast Water

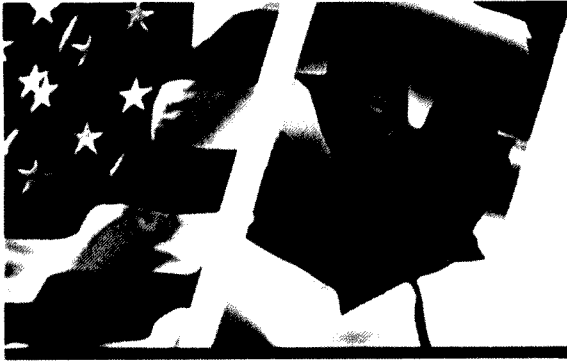
- The United States Coast Guard continues to implement its rulemaking that established a performance standard for the allowable concentration of living organisms in ballast water discharged from ships in waters of the United States. Five independent laboratories are in the process of testing multiple systems for type approval³. Numerous additional vendors have filed a Letter of Intent to begin type approval testing.
- Additionally, the Coast Guard currently has issued 56 interim Alternative Management System determinations for ballast water treatment systems and the Coast Guard expects type approval applications from several of these manufacturers. These designations are intended as a bridging strategy to allow for the use of Ballast Water treatment systems that are type-approved by foreign administrations in accordance with the International Maritime Organization Ballast Water Management Convention of 2004.
- The first four ballast water management systems (BWMSs) type approval applications submitted to the Coast Guard proposed using an alternative test method of determining the efficacy of the ultraviolet BWMSs. A subsequent Coast Guard review concluded that the alternative test method was not equivalent because it does not measure the efficacy of the BWMSs to the required performance standard required by the regulations and the BWMSs were not approved.
- Through the Great Lakes Restoration Initiative, the United States supported the independent performance testing of ballast water systems for use in freshwater ecosystems. During 2013 to 2015, numerous ballast water systems were tested at the Great Ships Initiative facility in Superior, Wisconsin. The Great Ships Initiative (www.greatlakesinitiative.org) mission is to

³ Type Approval is the primary process for equipment and materials to receive United States Coast Guard approval. See http://www.uscg.mil/hq/cg5/cg5214/eqpt_approval.asp for further information.

accelerate research, development and implementation of effective ballast water management systems (BWMSs) on board commercial vessels that visit the Great Lakes region from abroad.

- In addition, the following ballast water research studies were undertaken by the United States:
 - Investigation Of Ballast Water Treatment's Effect On Corrosion (<http://www.dtic.mil/get-tr-doc/pdf?AD=ADA613423>)
 - Ballast Water Treatment, U.S. Great Lakes Bulk Carrier Engineering and Cost Study, Volume 1: Present Conditions (<http://www.dtic.mil/get-tr-doc/pdf?AD=ADA589870>)
 - Ballast Water Treatment, U.S. Great Lakes Bulk Carrier Engineering and Cost Study, Volume 2: Analysis of On-Board Treatment Methods, Alternative Ballast Water Management Practices, and Implementation Costs (<http://www.dtic.mil/get-tr-doc/pdf?AD=ADA589362>)
 - Results of Shipboard Approval Tests of Ballast Water Treatment Systems in Freshwater (<http://www.dtic.mil/get-tr-doc/pdf?AD=ADA613767>)
 - Efficacy of Ballast Water Treatment Systems: A Report by the EPA Science Advisory Board (<http://www.dtic.mil/get-tr-doc/pdf?AD=ADA550605>).

2016



AQUATIC INVASIVE SPECIES ANNEX

PROGRESS REPORT OF THE PARTIES

OVERVIEW

Aquatic invasive species (AIS) currently in the Great Lakes are undermining efforts to restore and protect ecosystem integrity and water quality. These organisms have “re-engineered” the way nutrients and chemical contaminants move within the Great Lakes ecosystem, affecting the productivity of the lakes and disrupting integrity of food webs. These ecological effects of AIS have resulted in significant socio-economic impacts on the Canadians and Americans whom depend on the Great Lakes.

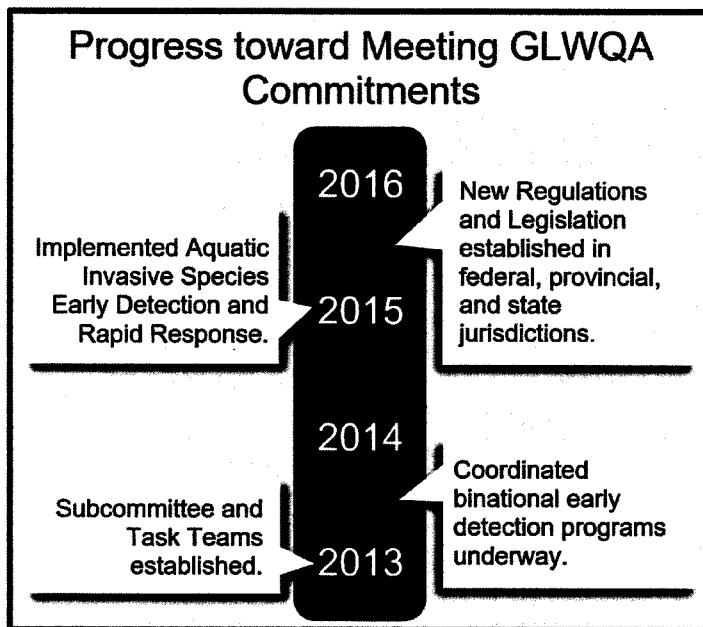
New potential invaders, such as Asian carps, threaten to further disrupt the integrity of Great Lakes ecosystems.

After invasive species become established in the Great Lakes, they are costly to control and nearly impossible to eradicate. Consequently, prevention is the most effective approach to dealing with these threats. The 2012 GLWQA commits the United States and Canada to: 1) preventing the introduction of AIS; 2) controlling or reducing the spread of existing AIS; and 3) eradicating, where feasible, existing AIS within the ecosystem.

The United States and Canada are working to identify and minimize the risk of Asian carps and other species invading the Great Lakes using a risk-assessment approach to better understand the risks posed by species and pathways and by implementing actions to manage those risks. Through efforts of federal, state, and provincial agencies, Canada and the United States have developed and implemented an early detection and rapid response initiative with the goal of finding new invaders and preventing them from establishing self-sustaining populations. This basin-wide effort resulted in several new detections of Grass Carp that triggered coordinated rapid responses by all involved agencies.

Coordinated actions have had significant success. As described, in the previous chapter about *Discharges from Vessels*, due to United States and Canadian regulations requiring ships to exchange their ballast water with salt water from the open ocean and a coordinated program of monitoring compliance of 100% of ships entering the St. Lawrence Seaway, no new invaders have been introduced by ships since 2006 (see Figure 10). The efforts undertaken since the inception of the 2012 GLWQA have contributed to the continuing success of no new AIS becoming established in the Great Lakes.

The threat of new AIS is ever-present and, in spite of this success, continued and new actions are critical. For example, the recently detected evidence of Grass Carp reproduction in the Sandusky River, a tributary to Lake Erie in north-central Ohio in the United States, is of great concern. The United States and Canada are committed to further improving and strengthening AIS actions and initiatives under the Aquatic Invasive Species Annex.



This Annex is being implemented by the Aquatic Invasive Species (AIS) Annex Subcommittee, co-led by the United States Fish and Wildlife Service and Fisheries and Oceans Canada. The AIS Annex Subcommittee delivers its work in close cooperation with the Great Lakes Panel on Aquatic Nuisance Species, which is supported by the Great Lakes Commission and is partially funded by the United States Fish and Wildlife Service. Organizations on the subcommittee include: United States Fish and Wildlife Service, 1854 Treaty Great Lakes, Chippewa Ottawa Resource Authority, Great Lakes and St. Lawrence Cities Initiative, Indian Fish and Wildlife Commission, Michigan Department of

Environmental Quality (Office of the Great Lakes), Michigan Department of Natural Resources, Minnesota Department of Natural Resources, New York Department of Environmental Conservation, Ohio Department of Natural Resources, United States Environmental Protection Agency, United States Geological Survey, United States National Oceanic and Atmospheric Administration, Wisconsin Department of Natural Resources, Great Lakes Commission, Great Lakes Fishery Commission, The Nature Conservancy, Fisheries and Oceans Canada, Chiefs of Ontario, Environment and Climate Change Canada, Ontario Ministry of Natural Resources, and the Ontario Federation of Anglers and Hunters.

Binational Actions Taken

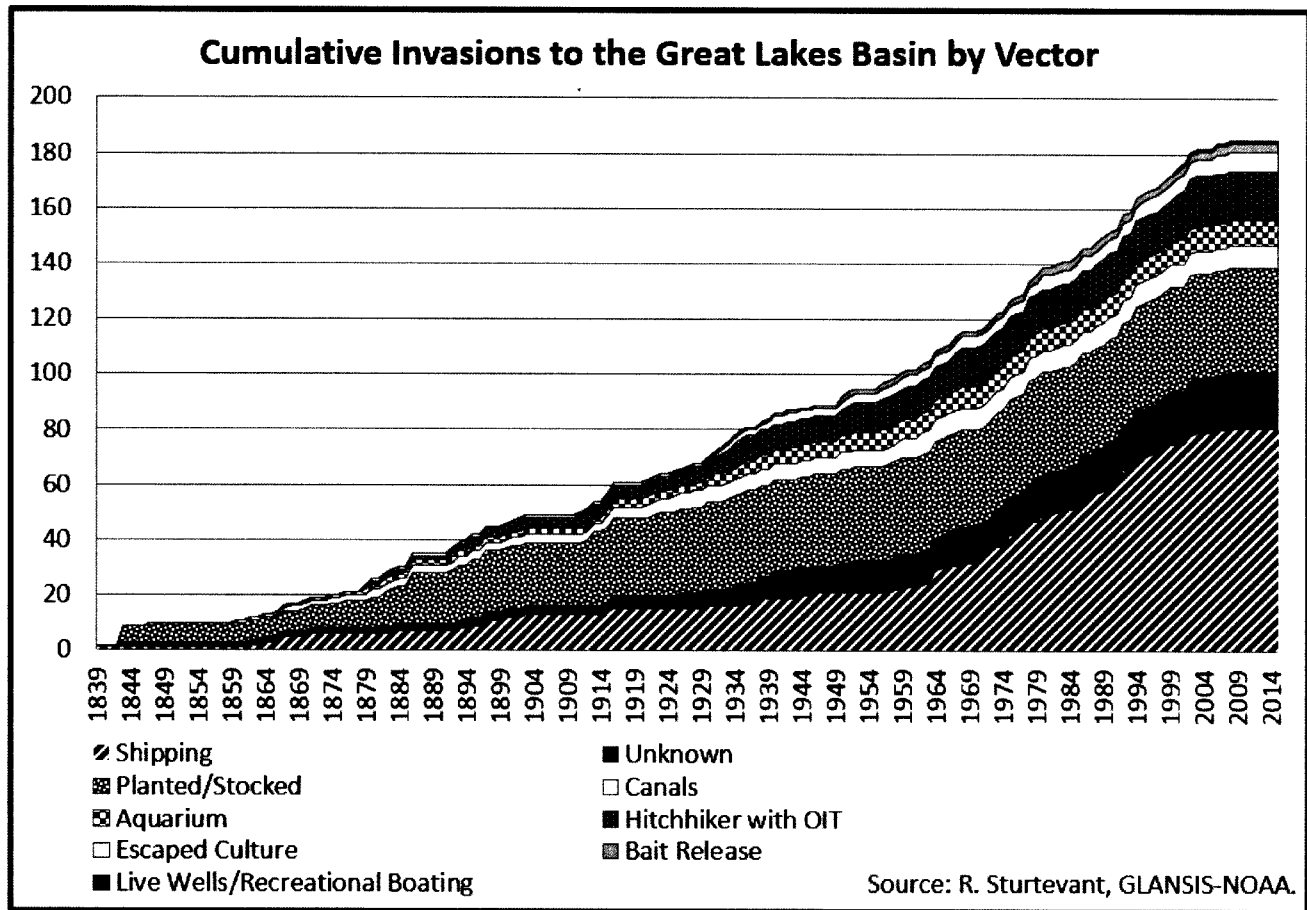
Conducting risk assessments on Aquatic Invasive Species for their entry into the Great Lakes.

- The United States and Canada undertook a review of existing species risk assessments, in coordination with Great Lakes jurisdictions and their partners. Based on this analysis, a binational assessment of the ecological risks and impacts related to Grass Carp establishment was completed, and is being peer-reviewed. A similar binational risk assessment is being completed for Black Carp, currently known to occur in the middle Mississippi River and the last of the four Asian carp species that potentially threaten the Great Lakes.
- In 2013, the Conference of Great Lakes and St. Lawrence Governors and Premiers established a list of 16 "least wanted" species for the Great Lakes, based on a review of risk assessments by their Aquatic Invasive Species Task Group.
- Members of the Aquatic Invasive Species Annex Subcommittee are supporting work of the Conference of Great Lakes and St. Lawrence Governors and Premiers Aquatic Invasive Species

Task Group to harmonize approaches to address aquatic invasive species across the basin with a focus on species risk assessments.

- A risk analysis of illegal trade and transport into Great Lakes jurisdictions was completed and a report of these findings was delivered to the Great Lakes Fishery Commission's binational Law Enforcement Committee. The report recommends risk management efforts to address the unacceptable risks documented for species regulated by state, provincial, and federal agencies in the internet, live bait, live food, aquaculture, private pond/lake stocking, water garden, aquarium/pet, and cultural release pathways. The AIS Subcommittee will continue to work with the Law Enforcement Committee to address risk management needs described in the risk analysis report.
- A new web-based tool called, *Great Lakes Detector of Invasive Aquatics in Trade*, has been developed by the Great Lakes Commission to better quantify the threat posed by the internet commerce pathway. The tool is available to managers in the United States and Canada to inform and help target risk assessment, monitoring and surveillance, and enforcement of aquatic invasive species available for purchase on the internet.
- In the United States, a government-industry partnership is working toward development of new United States recreational boat design standards for building new "AIS-Safe Boats," and development of United States standards for AIS removal from existing recreational boats.
- In Canada, a National Recreational Boating Risk Assessment, with focus on the potential movement of AIS within Canadian and United States waters of the Great Lakes, was carried out during 2015, and the products of this assessment will assist in identifying areas to focus on minimizing risk of recreational boaters spreading AIS.

Figure 10 – Joint United States and Canada Ballast Water Exchange Management Success in Preventing Invaders.



Historically, an average of one non-native species was found to be established in the Great Lakes about every 8 months. Most of those introductions resulted from ballast water discharge. No ballast-mediated introductions, and no additional introductions from other pathways, have resulted in establishment of a non-native species since 2006. The success of joint United States and Canada ballast water exchange management has been a major contributor, with no new introductions attributable to ships since 2006.

Undertaking outreach and engagement in support of meeting various annex commitments.

- While most outreach and engagement efforts are implemented domestically, experts from government agencies and non-government groups are working across jurisdictional lines to share resources and approaches that modify human behavior so as to minimize the risk of people spreading AIS.

- To support this work, the binational Great Lakes Panel on Aquatic Nuisance Species' Information and Education Committee developed a synthesis of communication and education campaigns, programs, and products, which support prevention efforts for a variety of pathways, including recreational boating.

By 2015, develop and implement an Aquatic Invasive Species early detection and rapid response initiative.

- The United States and Canada developed an AIS early detection and rapid response initiative which included a number of strategies to prevent the introduction and spread of AIS. Early detection and rapid response provide a strong second line of defense to augment species prevention efforts by quickly finding AIS populations, including Asian carps, while they are still contained within relatively small areas and preventing them from becoming established. These efforts mark the first basin-wide early detection network in the history of the Great Lakes, an effort that will be strengthened and enhanced in the future. A full account of the achievements to date under the initiative is available at www.binational.net (<https://binational.net/2015/02/23/ais-early-detection/>).
- Key components of the AIS early detection and rapid response initiative include:
 - An "AIS species watch list" of those species of the highest priority and likelihood of risk of invading the Great Lakes;
 - A list of priority locations to undertake surveillance for the potential introduction of species on the "AIS species watch list";
 - Protocols for systematically conducting monitoring and surveillance methodologies such as sampling for environmental DNA (*i.e.*, "free" DNA found in water) and sampling using gears that collect fishes and bottom-dwelling invertebrates so that a potential invader is promptly observed and reported;
 - The sharing of relevant information amongst the responsible departments and agencies to ensure prompt detection of invaders and prompt coordinated actions to respond to them; and
 - The coordination of plans and preparations for any response actions necessary to prevent the establishment of newly detected AIS.
- The Conference of Great Lakes and St. Lawrence Governors and Premiers provided critical leadership with the establishment of a Mutual Aid Agreement to empower the states and provinces to work collaboratively and to share resources and expertise to deal with AIS that pose a regional threat.

Implementing early detection and rapid response.

- Binational early detection and rapid response for Asian carps have been a focus for Canada and the United States. The Asian carp actions include: establishing priority locations for potential invasion guided by risk assessments; sharing protocols for early detection monitoring; coordinated communication protocols; and coordinated response planning.

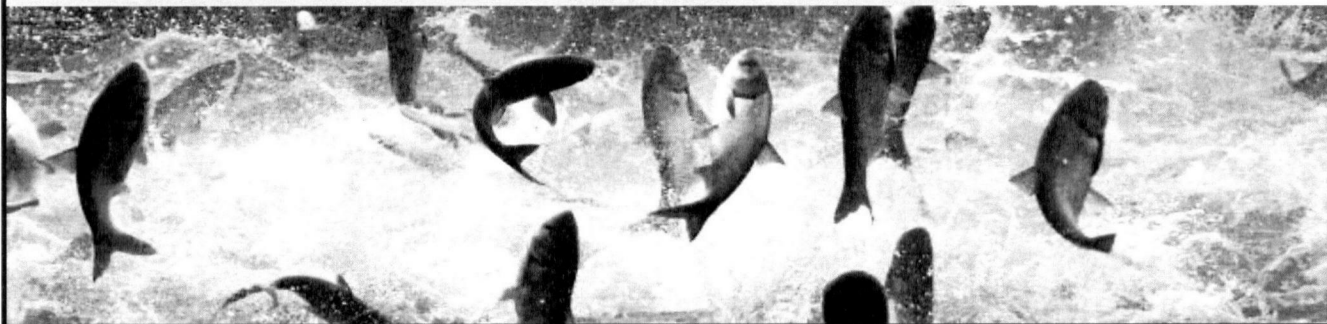
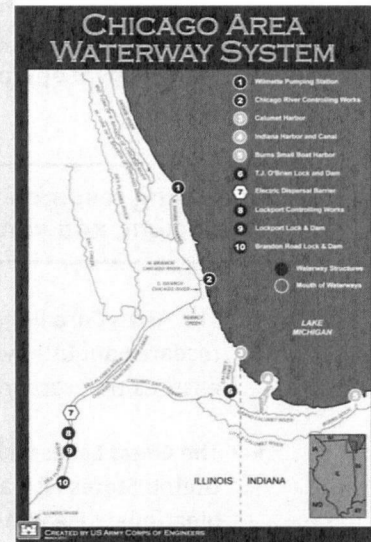
- Detections of Grass Carp in Canadian waters triggered fully coordinated implementation of response plans under the incident command system. Those successful responses provided real-world testing of the Canadian domestic response framework.
- On Lake Superior, a binational early detection program has been implemented by United States federal, state, and tribal agencies and the province of Ontario. This coordinated effort has benefited from a performance evaluation of early detection monitoring surveillance programs which revealed new opportunities to substantially increase the speed and sensitivity of detecting newly-introduced species. By focusing efforts on areas within ports known to carry rare and invasive species, and by increasing the use of sampling equipment that captures a wide diversity of organisms, the effectiveness at detecting invasive species has nearly doubled. To continue improvement in the future, the United States Environmental Protection Agency, the United States Fish and Wildlife Service, and their partners have implemented an adaptive management approach using a cycle of review and ongoing refinement of the surveillance program.

Conducting research to develop and test Aquatic Invasive Species detection, containment, and control technologies.

- The Asian Carp Regional Coordinating Committee provides a forum for coordination of new research about how to detect, control or contain Asian carps. The critical exchange of science ensures that research in the United States and in Canada is complementary and synergistic.
- The Great Lakes Fishery Commission, working with the United States Geological Survey, the United States Fish and Wildlife Service, and Fisheries and Oceans Canada, delivers an ongoing binational research effort to find new ways to control Sea Lampreys and to improve the methods that are used today. An example of a new tool is the Sea Lamprey mating pheromone, 3kPZS, which was officially registered in the United States and Canada as the first ever vertebrate pheromone biopesticide. Like an alluring perfume, the mating pheromone is a scent released by male Sea Lampreys to lure females onto nesting sites. The mating pheromone has been used as bait in traps that collect and remove adult Sea Lampreys before they have a chance to spawn. Research and development of the mating pheromone was funded by the Great Lakes Fishery Commission, with additional support from the Great Lakes Restoration Initiative, in collaboration with federal governments, university, and private industry partners.

Figure 11 - Battling Asian Carp Together.

The Asian Carp Regional Coordinating Committee (ACRCC) was formed in 2009 to address the growing threat from established and expanding populations of Asian carps in the Mississippi River basin with the focus on Great Lakes protection. The ACRCC, co-chaired by the United States Environmental Protection Agency and the United States Fish and Wildlife Service, has grown to a binational partnership of 27 United States and Canadian federal, state, provincial, and local government agencies working in coordination to prevent the introduction, establishment, and spread of Bighead, Black, Grass, and Silver carp populations in the Great Lakes. The ACRCC has developed a comprehensive, multi-pronged approach, heavily focused on prevention and control opportunities in the Illinois Waterway and Chicago Area Waterway System as the primary potential pathway for dispersal toward the Great Lakes; basin-wide, binational surveillance and early detection for Asian carp; and assessment and closure of secondary pathways of potential introduction in Indiana and Ohio, as indicated in the Great Lakes and Mississippi River Interbasin Study (GLMRIS). The ACRCC approach, embodied in its annual strategy, the Asian Carp Action Plan (Action Plan) (<http://www.asiancarp.us/documents/2016AsianCarpActionPlan.pdf>), has evolved to include progressively more aggressive Asian carp management through targeted removal of Bighead and Silver carp in upstream locations in the Illinois Waterway; development of increasingly advanced genetics-based early detection technologies for use in basin-wide monitoring; use of risk assessment to inform the implementation of key management projects (e.g., to achieve GLMRIS pathway closures, and to guide Grass Carp surveillance in Canadian waters) and studies of additional possible pathways of introduction, including potential entrainment and transit of small fish in barges; the identification and development of new potential control tools and integrated pest management strategies; and comprehensive communications on Asian carp developments with policy makers, partners and stakeholders in the United States and Canada. While a key component in the strategy for Great Lakes defense remains the operation and expansion of the Corps of Engineers' electric dispersal barrier system near Chicago, the Action Plan has evolved to include a holistic portfolio of over 60 projects being implemented by member agencies, supported through federal, state and provincial agency base funds and the Great Lakes Restoration Initiative. The Action Plan is complemented by the partnership's annual Monitoring and Response Plan (<http://www.asiancarp.us/documents/MRP2016.pdf>), the tactical plan that prescribes the specific time, location, and duration of the many coordinated agency monitoring and control actions conducted throughout the year. The 2016 Monitoring and Response Plan includes new contingency for "emergency response" plans that provide specific recommendations of "shelf-ready" rapid-response control options currently available for use by the state and federal response agencies in the event the upstream movement of any life stage of Asian carp is detected above a pre-determined threshold in key upstream navigation pools in the Illinois Waterway and the Chicago Area Waterway System. The primary focus of the contingency plans is on actions for defending navigation pools in the Illinois Waterway immediately downstream of the Brandon Road Lock and Dam. The ACRCC continues to strategically contain established populations of Asian carps below that lock and dam to prevent Asian carp population establishment in the Great Lakes. Additional information on the ACRCC partnership's binational efforts can be found at www.asiancarp.us and www.asiancarp.ca.



Domestic Actions Taken



Conducting risk assessments on Aquatic Invasive Species for their entry into the Great Lakes.

- Approximately 160 risk assessments were conducted by the United States on non-native species and published on www.fws.gov (http://www.fws.gov/fisheries/ANS/species_erss_reports.html). These risk assessments have identified high risk fish, crustaceans, and mollusks that thrive in climates similar to the Great Lakes basin and could become established if they are introduced in large enough numbers.
- The risk of barge shipping-related inadvertent entrainment and transport of small fishes within the Chicago Area Waterway System was evaluated, and the resulting report delivered to the Asian Carp Regional Coordinating Committee, industry, and the public. Results indicate that small free-swimming fish, including surrogate fish placed in and around barges by researchers and wild fish, can become trapped and remain between barges for substantial distances. In one trial, live fish were transported more than nine miles up the Illinois Waterway and Chicago Area Waterway System, travelling progressively upstream through the Brandon Road Pool, Lockport Lock, and, finally, the United States Army Corps of Engineers' electric dispersal barriers, near Chicago. Further studies on the susceptibility of actual small (juvenile) Asian carps to becoming entrained and transported under realistic conditions, methods to clear all fish from these barge-to-barge junction spaces, and improvements in barge operation best management practices to minimize likelihood of entrainment are being pursued to reduce this risk.

Preventing introduction and spread of Aquatic Invasive Species through regulations.

- Based on risk assessments and supporting science, the State of Michigan amended its prohibited species list to include several new invasive species. Additional information can be found at: <http://www.michigan.gov/invasives/0,5664,7-324-68071---,00.html>.
- Similarly, the State of New York has recently amended their regulations, effective March 2015, to prohibit species to affect more control of the risk of new invaders. Additional information can be found at <http://www.dec.ny.gov/animals/99141.html>.
- The United States Fish and Wildlife Service has proposed adding 11 non-native freshwater species to the list of injurious species under the Lacey act. Ten fishes (Crucian Carp, Eurasian Minnow, Prussian Carp, Roach, Stone Moroko, Nile Perch, Amur Sleeper, European Perch, Zander, Wels Catfish) and one crayfish (common yabby) are included in the proposed rulemaking. A final rule is planned for release in 2016.

Implementing early detection and rapid response.

- Great Lakes states have been actively monitoring and responding to detections of invasive species, including recent response actions following detection of invasive Water Lettuce, New Zealand Mudsnail, Parrot Feather, Red Swamp Crayfish, Water Hyacinth, Water Chestnut, European Frogbit, Starry Stonewort, Northern Snakehead, and small killifish (Mummichog).
- The invasive species Hydrilla was discovered in the Cayuga Lake Inlet and Erie Canal in central New York. Aggressive eradication projects started at both locations in response to concerns about the spread of this invasive plant species throughout the Great Lakes basin. Despite signs of a successful control, eradication may take several more years due to ability of root systems to lay dormant in the sediment. More information about Hydrilla can be found at <http://stophydrillawny.org/>.

Conducting research to develop and test Aquatic Invasive Species detection, containment, and control technologies.

- U.S. federal partners carried out development and testing to advance the use of near-real time environmental DNA (eDNA)-based analysis in the field to support law enforcement efforts for effectively detecting and interdicting illegal transport of Asian carp species into Great Lakes jurisdictions (eDNA is the “free” genetic material left behind by an organism and evident in water column).
- United States federal partners continue to evaluate the potential use of carbon dioxide as an environmentally sound approach to help contain or repel Asian carps in strategic confined locations (e.g., lock and dam approach channels, river/embayment confluences) to prevent additional introductions and limit further range expansion.
- Work was initiated in the United States on the development and testing of a system to deliver a pesticide (Antymycin) that can kill Bighead and Silver Carps while not harming other fishes. This technology could be used to reduce populations in the Chicago Area Waterway System and Illinois River, which would further reduce the risk of Asian carps becoming established in the Great Lakes.
- New molecular genetic techniques are being developed for detecting rare invasive species. Current research efforts funded by the Great Lakes Restoration Initiative (GLRI) have focused on: 1) expanding the use of environmental DNA; 2) genetic analyses of larval fish samples to detect the reproduction of invasive fishes; and 3) genetic analyses of lake sediments or benthos for detection of invasive species such as the Zebra Mussel, Quagga Mussel, and New Zealand Mudsnail. The current trend of advancing molecular genetic methods coupled with decreasing costs is highly promising.
- Based on extensive testing, the commercial product “Zequanox” was approved for open-water use to control invasive Zebra and Quagga mussels in lakes and rivers. United States agency and academic partners are exploring its strategic use in the Great Lakes and inland lakes. Zequanox

is composed of dead cells derived from a naturally occurring soil microbe, and it controls invasive mussels in all life stages. Its active ingredient has low toxicity and presents little risk to non-target organisms.

- The United States is funding and supporting new methods to control the spread of invasive aquatic plant *Phragmites* including:
 - Research at Cornell University to identify insects that kill *Phragmites*. The researchers are evaluating the host-specificity of each insect species in preparation for wide-spread releases of insects that may help control *Phragmites* populations.
 - Work by the United States Geological Survey and its partners to identify the fungal microbes that help provide nutrients to non-native *Phragmites*, and work to find ways to slow *Phragmites* growth by disrupting this symbiotic relationship.
 - Work by Wayne State University and United States Geological Survey scientists to silence important genes in *Phragmites* (e.g., those for flowering, seed set, and photosynthesis) in an effort to reduce its competitive advantage. Cooperating scientists are testing gene silencing of photosynthesis in *Phragmites*. The next step will be to test the technology in the field and develop an application method that will be feasible over a large scale.
 - More information about *Phragmites* can be found at <http://greatlakesphragmites.net/research/control-options/>.

Assessing the potential impacts of climate change on Aquatic Invasive Species.

- A climate change projection tool was developed that can project the AIS climate niche, within the Great Lakes basin, under several climate change scenarios published by the Intergovernmental Panel on Climate Change (<http://www.ipcc.ch/>) for the years 2050 and 2070.



Conducting risk assessments on Aquatic Invasive Species for their entry into the Great Lakes.

- During 2013, a national risk assessment of ballast water introductions of AIS species was completed with a focus on the Great Lakes and St. Lawrence River. That risk assessment identified the need to reduce risk by incorporating ballast water treatment into systems of ships that discharge ballast into the Great Lakes.
- During 2013, a peer review of available risk assessment tools was carried out, and science advice was published, about screening-level risk assessment protocols for non-indigenous freshwater organisms in trade in Canada that provides guidance to evaluating risks to support prevention actions.

- Ontario Ministry of Natural Resources and Forestry has conducted 14 draft risk assessments for non-native fishes, aquatic invertebrates and plants. The risk assessments will be used in support of regulations under the new Invasive Species Act, 2015.

Preventing introduction and spread of Aquatic Invasive Species through regulations.

- With extensive public and government consultation, Canada established new aquatic invasive species regulations under the Fisheries Act in June of 2015 creating new prohibitions for species based on risk and enabling new measures for prevention and control of AIS in Canada and at its borders.
- In November of 2014, the Province of Ontario reintroduced the proposed Invasive Species Act, to support the prevention, early detection, rapid response and eradication of invasive species in the province. The Ontario Invasive Species Act, 2015, received Royal Assent on November 3, 2015 and comes into force on November 3, 2016. A risk assessment process will be used to classify species for regulation that pose a threat to Ontario's natural environment, including the Great Lakes.

Implementing early detection and rapid response.

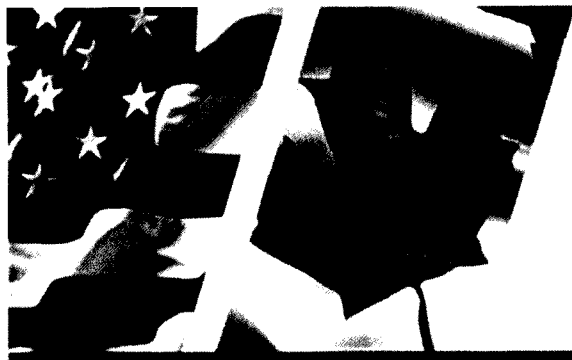
- Canada, working closely with Ontario and United States jurisdictions, has delivered its Asian Carp Program based on four pillars: prevention, early warning, response, and management. The program includes extensive early detection surveillance activities in close conjunction with environmental DNA monitoring carried out by Ontario. More information can be found at <http://asiancarp.ca/>.
- Canada, in coordination with the Ontario Federation of Anglers and Hunters, the Invasive Species Centre, and Royal Ontario Museum carried out a large-scale outreach campaign intended to raise awareness and public understanding of best practices to prevent the transport and spread of Asian carps.
- The Ontario Federation of Anglers and Hunters, in partnership with Ontario, engage the public in citizen science to detect invasive species through the Ontario Invasive Species Awareness Program, reporting hotline, and new tools like the Early Detection and Distribution Mapping System (EDDMaps Ontario) smartphone app.
- Findings of Grass Carp in Lakes Erie and Ontario between 2013 and 2015 have triggered successful coordinated response efforts under the incident command system testing the domestic response framework established for Asian carps.
- Extensive efforts continue to respond to the establishment of Water Soldier, an invasive aquatic plant, first discovered in 2008 in the Trent Severn Waterway in Ontario. Ontario, Parks Canada, the Ontario Federation of Anglers and Hunters, the Conservation Authority, and other partners are collaborating to prevent further spread, to detect any expansion of the plant's range and

respond to new findings, and to eradicate the established population through chemical and mechanical control measures.

Conducting research to develop and test Aquatic Invasive Species detection, containment, and control technologies.

- Research has been completed on the capacity for invasive fish species, including Asian carps, to move through the Welland Canal and the St. Marys River canals to help better understand the risk of spread and opportunities for control.
- Research on repulsion devices, including sound, light, and electricity, to potentially contain and control fish species, including Asian carps, has been carried out using surrogate species in a large-scale mesocosm located in Hamilton Harbour, Lake Ontario.
- Canada continues to actively research monitoring and treatment technologies to advance efforts to prevent AIS movement in the ballast water of ships including evaluation of the current binational ballast water exchange monitoring program, testing of ballast water treatment technologies, and evaluation of sampling methods to support new International Maritime Organization ballast water standards.
- Ontario and Canada are carrying out research to advance the application of environmental DNA for the detection of AIS for Asian carps, Water Soldier, Zebra Mussels, and other species, focusing on refinement of quality control procedures, refinement of detection sensitivities, and the establishment of new markers.

2016



HABITAT AND SPECIES ANNEX

PROGRESS REPORT OF THE PARTIES

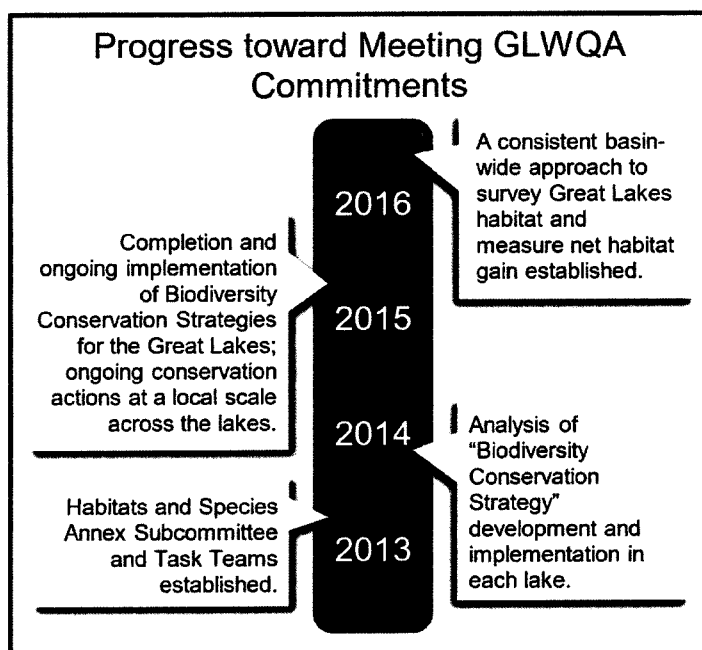
OVERVIEW

The Great Lakes basin is a vast freshwater system consisting of a wide range of habitats from sand dunes and rocky shorelines to wetlands and shoals. These habitats are home to a great wealth of biodiversity including many globally rare species. This ecological diversity is an important resource to the region providing valuable ecosystem services (such as clean drinking water and harvestable fish) that contribute to the well-being of Great Lakes basin residents. Protection of the habitats, and the species that rely on these habitats, is an important component of managing the Great Lakes.

The 2012 GLWQA commits Canada and the United States to conserve, protect, maintain, restore and enhance the resilience of native species and their habitats, as well as supporting essential ecosystem services in the basin. Actions taken by the Parties are contributing to the recovery of populations of species at risk and the restoration of degraded native habitat and species.

This Annex's implementation is supported by the Habitat and Species Annex Subcommittee, co-led by Environment and Climate Change Canada and the United States Fish and Wildlife Service. Organizations

on the Subcommittee include: **Environment and Climate Change Canada**, Fisheries and Oceans Canada, Ontario Ministry of Natural Resources and Forestry, Parks Canada, Ontario Federation of Anglers and Hunters, **United States Fish and Wildlife Service**, Indiana Department of Environmental Management, Michigan Department of Natural Resources, New York State Department of Environmental Conservation, United States Army Corps of Engineers, United States Environmental Protection Agency, United States Geological Survey, United States National Oceanic and Atmospheric Administration, United States National Park Service, Wisconsin Department of Natural Resources, and Great Lakes Fishery Commission.



Binational Actions Taken

By 2015, develop Biodiversity Conservation Strategies for all of the lakes, including connecting channels, and begin implementing priority actions identified in the Strategies through existing programs and agreements.

- Lakewide habitat and species protection and restoration conservation strategies, also called Biodiversity Conservation Strategies (Strategies), were developed for all five of the Great Lakes as of February 12, 2015. The Strategies assess the status and threats to lakewide biodiversity and recommend conservation priorities for native species and their habitats. The Executive Summaries (the covers of which are shown in Figure 12) are available on binational.net (www.binational.net/2015/02/23/habitat-and-species-strategies).

Figure 12 – Lakewide Habitat and Species Protection and Restoration Conservation Strategies.

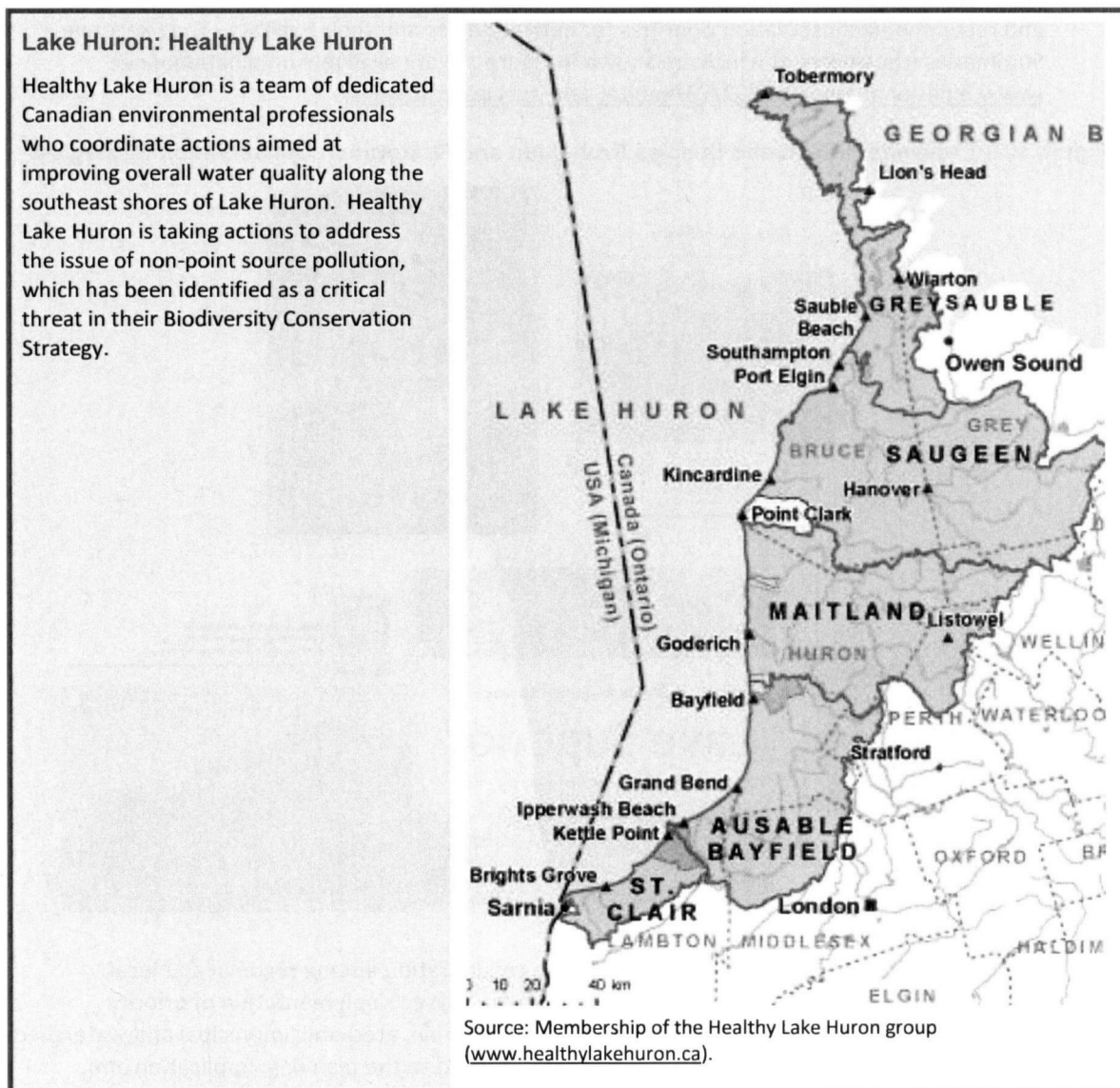


- Each Strategy is a product of extensive lakewide collaboration among regional and local stakeholders. They serve as tools to foster and guide shared implementation of priority conservation actions among federal, state, provincial, tribal, academic, municipal and watershed management agencies. Adaptive management is applied to the planning, application and implementation of the Strategies across the lakes.
- The Lake Superior Partnership is currently preparing watershed-level plans to further guide and support implementation of the 2015 Biodiversity Conservation Strategy at a local level. The

Lake Ontario Partnership used the broader Lake Ontario Biodiversity Strategy to produce an implementation plan to focus effort on priority actions. Other Lake Partnerships are promoting implementation by identifying regional scale and watershed based biodiversity objectives and outlining the specific actions required to address habitat and species issues on a sub-basin scale.

- Figure 13 illustrates several examples of how the Strategies are being used in each lake basin to inform and implement priority conservation actions.

Figure 13 – Examples of How Biodiversity Conservation Strategies are Being Used in Each Lake Basin to Inform and Implement Priority Conservation Actions.





The Camp 43 Dam on the Black Sturgeon River, Ontario. Credit: Ontario Ministry of Natural Resources and Forestry.

Lake Superior: Superior Streams

The Lake Superior Biodiversity Conservation Strategy classified dams and barriers as a high threat to meeting biodiversity targets. Dams and barriers also prevent the spread of aquatic invasive species. For example, the pictured dam on the Black Sturgeon River limits Lake Sturgeon and Walleye spawning habitat, but also prevents significant Sea Lamprey infestation. Work on understanding these trade-offs is underway by Lakehead University and by the Aquatic Habitat Connectivity Collaboration supported by the Great Lakes Fishery Commission. Decisions about maintaining or removing dams require engagement with all stakeholders and Indigenous peoples to help ensure that all views and objectives are considered.



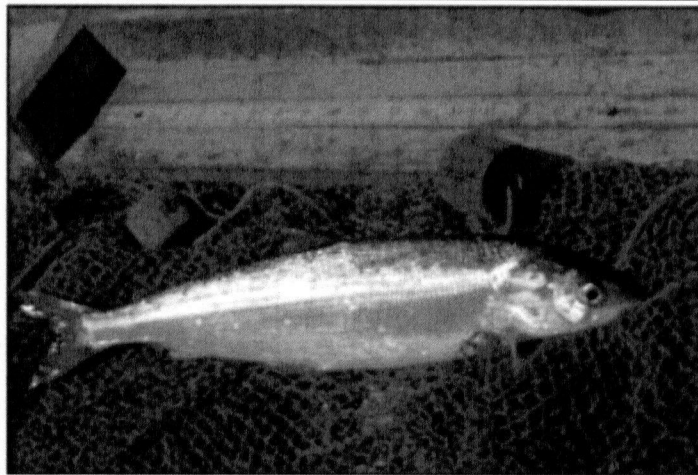
Dale Hanson from the Green Bay Fish and Wildlife Conservation Office assists with bloater egg collection for use in Lake Ontario. Credit: United States Fish and Wildlife Service.

Lake Ontario: Bloater Fish Stocking

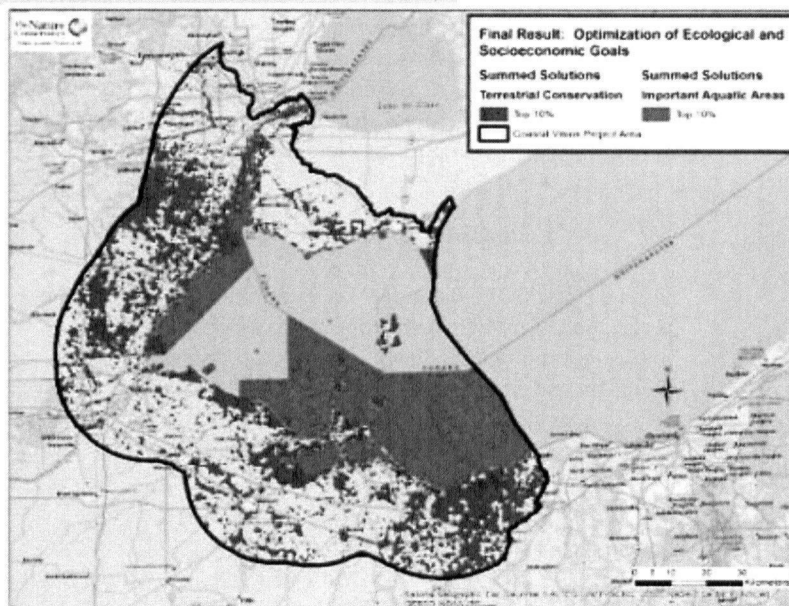
In Lake Ontario, the Binational Lake Partnership identified the restoration of native preyfish species as a priority for the implementation of the Biodiversity Conservation Strategy. Canadian and United States agencies have initiated a program to reintroduce bloater to the lake in 2012. The program is ongoing, and nearly 62,000 bloaters were released in November 2015.

Lake Michigan: Lake Herring Restoration

Restoration of the native Lake Herring is a priority identified in the Lake Michigan Biodiversity Conservation Strategy. To help restore the species to its historical status as a primary prey fish in Lake Michigan, the Little Traverse Bay Bands of Odawa Indians released nearly 50,000 summer fingerlings and 8,000 fall fingerling into Little Traverse Bay, Michigan, in 2014. The Little Traverse Bay Bands of Odawa Indians is currently evaluating the success of the fingerling releases.



Lake Herring. Credit: United States Environmental Protection Agency.



Lake Erie: Western Basin Conservation Vision

Targets and goals from the Lake Erie Biodiversity Conservation Strategy were used in the development of a regional implementation plan called the Western Basin Conservation Vision. This plan identifies and maps areas to focus local conservation investments to meet regional conservation goals.

Source: Final Results of the Optimization of Ecological and Socioeconomic Goals (<https://www.conservationgateway.org/ConservationByGeography/NorthAmerica/wholesystems/greatlakes/coasts/wle/Pages/default.aspx>).

Conducting a baseline survey of the existing habitat against which to establish a Great Lakes Basin Ecosystem target of net habitat gain and measure future progress.

- The Parties released a draft report entitled Conducting a Baseline Survey of Great Lakes Habitat: Assessing and Measuring Progress toward a Great Lakes Ecosystem Target of Net Habitat Gain, in May 2016, identifying an approach to measure baseline conditions of habitat and monitor

change over time. The report was developed with support from experts and partners around the lakes through a series of binational workshops, meetings and webinars.

- The Baseline Survey approach is built upon existing Great Lakes monitoring programs and emphasizes the use of remotely sensed information for maximum data coverage. The physical characteristics of the lakes will be used to map different habitat types and the condition of the habitats will then be assessed. The baseline survey will be conducted on a reoccurring basis to track changes in the ecosystem over time and to monitor progress.

Domestic Actions Taken



- Canada and Ontario have multiple programs that contribute to the ongoing goals of the Habitats and Species Annex. In addition, there are many non-governmental partners making significant contributions to habitat and species conservation, including the Nature Conservancy of Canada, Conservation Ontario and the many individual Conservation Authorities in the province, the Ontario Federation of Anglers and Hunters, Ducks Unlimited Canada, and Stewardship Councils.
- Environment and Climate Change Canada's National Wetland Conservation Fund, which was launched in 2014, is a \$50 million funding program intended to support on-the-ground activities that will restore drained, degraded or lost wetlands across the country. Funding support has been provided to 39 projects in the Great Lakes basin, supporting actions that restore, protect, and conserve habitats for waterfowl, waterbirds and shorebirds. In the 2014 to 2015 fiscal year, 135 hectares of wetland habitat were restored and 6,440 hectares of wetland habitat were enhanced.
- The Lake Superior National Marine Conservation Area Legislation received Royal Assent in 2015, representing a significant step in establishing one of the world's largest fresh water marine protected areas. The Lake Superior National Marine Conservation Area encompasses a 10,800 square kilometer area of the biologically diverse lake and includes lakebed, islands, and shore lands. This project contributes to Canada's commitment to conserve the countries' land and waters and meet Aichi 2020 Biodiversity Targets to protect 17% of land and inland waters. The Lake Superior National Marine Conservation Area Interim Management Plan was released in January 2016 (<http://www.pc.gc.ca/eng/amnc-nmca/on/super/plan/interim-provisoire.aspx>).
- Through strategic partnerships and collaboration, the Ontario Ministry of Natural Resources and Forestry coordinates the Ontario Eastern Habitat Joint Venture (OEHJV), a program focused on conserving migratory bird habitats, particularly wetlands and their associated habitats. Environment and Climate Change Canada and the Ontario Ministry of Natural Resources and Forestry support OEHJV partners in the implementation of priority conservation programs, with a particular focus on wetlands and associated habitats identified within OEHJV Priority Habitat Conservation Areas. From April 2012 to March 2015, this venture has secured 5,550 hectares through 10-30 year conservation agreements, and enhanced 605 hectares of previously secured lands within the Great Lakes basin.
- Environment and Climate Change Canada completed biodiversity and aquatic habitat monitoring at more than 40 Great Lakes coastal wetlands each year, including surveys on fish, marsh birds,

aquatic invertebrates, vegetation, and water quality. Additionally, Environment and Climate Change Canada developed GIS mapping products to support reporting of Great Lakes basin biodiversity.

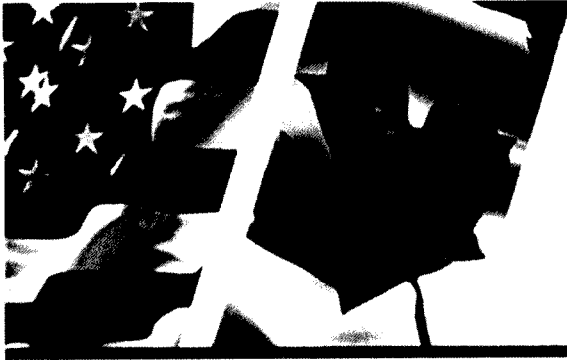
- The Government of Canada's Ecological Gifts program provides a way for Canadians with ecologically sensitive land to protect nature through donations of land, or a partial interest of land, for conservation in exchange for significant tax benefits. In the 2015 to 2016 year alone, 26 Ecological Gifts were completed in the Great Lakes basin for total of 1,247.48 hectares valued at \$8,853,800.
- The Province of Ontario is implementing a Land Stewardship and Habitat Restoration Program. Since its 2013 launch, the program's \$300,000 annual fund has helped improve, restore or create more than 4,662 acres of habitat including plantings of over 105,000 trees and shrubs, supporting the hiring of 182 people and leveraging over \$2.3 million in project-partner funding.
- Fisheries and Oceans Canada supports habitat restoration and enhancement through its Recreational Fisheries Conservation Partnerships Program. The program was established in June 2013 to support multi-partner projects at the local level aimed at restoring recreational fisheries habitat in order to enhance the sustainability and productivity of Canada's recreational fisheries.
- In May 2015, the Ontario Biodiversity Council released The State of Ontario's Biodiversity Report 2015. The report includes indicators that summarize data from monitoring programs to evaluate progress in achieving each of the 15 targets and status and trends in three biodiversity theme areas: pressures on biodiversity; state of ecosystem, species and genetic diversity; and, conservation and sustainable use. Several provincial ministries played a role in the development of the report.
- *Wetlands in Ontario: A Discussion Paper* was released by the Ontario Ministry of Natural Resources and Forestry for public consultation from July to October 2015. The purpose of the paper was to provide an overview of Ontario's current wetland conservation framework; to increase awareness about the main issues and concerns related to wetlands in Ontario; to provide stakeholders and the public with some ideas and priorities for wetland conservation in Ontario; and to solicit feedback from a diverse array of stakeholders and the public on the development of a Wetland Conservation Strategy for Ontario. A section on "Wetlands in the Great Lakes Basin" included a summary of inter-jurisdictional initiatives, including the GLWQA, that recognize the important role of wetlands in the Great Lakes, and seek to implement actions to protect and restore wetlands across the Great Lakes basin.



- In the United States, multiple federal and state agencies, as well as local and regional conservation entities, non-governmental organizations, and myriad conservation partners conduct a wide range of activities related to fish, wildlife and habitat. Many of these activities support goals and priorities of the Habitats and Species Annex. In addition to base-funded activities conducted by federal agencies, the Great Lakes Restoration Initiative (GLRI) has boosted funding in recent years to supplement agency budgets to allow them to pursue high priority conservation and restoration needs throughout the Great Lakes basin, including fish and wildlife habitat.

- In 2015, GLRI agencies and their partners implemented 57 habitat and species projects adding to the more than 800 habitat and species projects already underway or completed since the 2010 inception of the GLRI. Ten 2015 GLRI projects were directed towards protecting, restoring, and enhancing Piping Plover habitats. Over 40 projects have improved conditions for numerous federally and non-federally listed species in the Great Lakes such as Lake Sturgeon.
- GLRI funding implemented protection, restoration and enhancement projects that have reopened over 3,800 miles of Great Lakes tributaries and increased aquatic connectivity for numerous fish species. Additionally, more than 36,000 acres of habitat in targeted watersheds were protected, restored and enhanced in order to sustain Great Lakes habitats and species populations. Three-hundred miles of Great Lakes shoreline and riparian corridors and 7,000 acres of Great Lakes coastal wetlands were protected, restored, and enhanced in 2015 alone.
- GLRI partners have completed the removal of the Cass River Dam during 2015. The dam at Frankenmuth, Michigan initially blocked the passage of fish to more than 1,700 miles of upstream spawning habitat on the Cass River and connecting tributaries since it was built in the 1850s. The former dam site now has a rock ramp with a series of rock weirs to allow passage of fish species, such as walleye and Lake Sturgeon. Fourteen separate weirs and adjacent “resting pools” have been constructed over a span of approximately 350 feet to provide a roughly three percent grade for non-jumping targeted species.
- In 2015, GLRI partners reconnected the previously isolated Ottawa National Wildlife Refuge wetlands to Crane Creek and Lake Erie in Ohio. For the first time since the 1940s, the reconnected wetlands now function as a productive spawning ground and nursery area. Less than one week after re-establishing connectivity, Longnose Gar were found spawning in one of the pools. Thirteen species of fish not previously found entered through the structure and actively use the reconnected wetlands.
- The Fond du Lac Band of Lake Superior Chippewa developed better ways to control water levels and protect sustainable wild rice populations with GLRI funds. Projects included water control structures, beaver dam removals and channel obstruction removal that resulted in the protection of 855 acres of ecologically and culturally important wild rice habitat on the Fond du Lac Reservation in northeastern Minnesota. Federal partners and local Chippewa removed 97 acres of competing aquatic plant species from Big Rice Lake and 59 acres of aggressive perennial vegetation from Perch Lake. In the St. Louis River Estuary, partners reseeded 121 acres with wild rice. During the 2015 GLRI fiscal year, federal agencies and their partners restored and protected a total of 1,132 acres of wild rice habitat in Fond du Lac waters.

2016



GROUNDWATER ANNEX

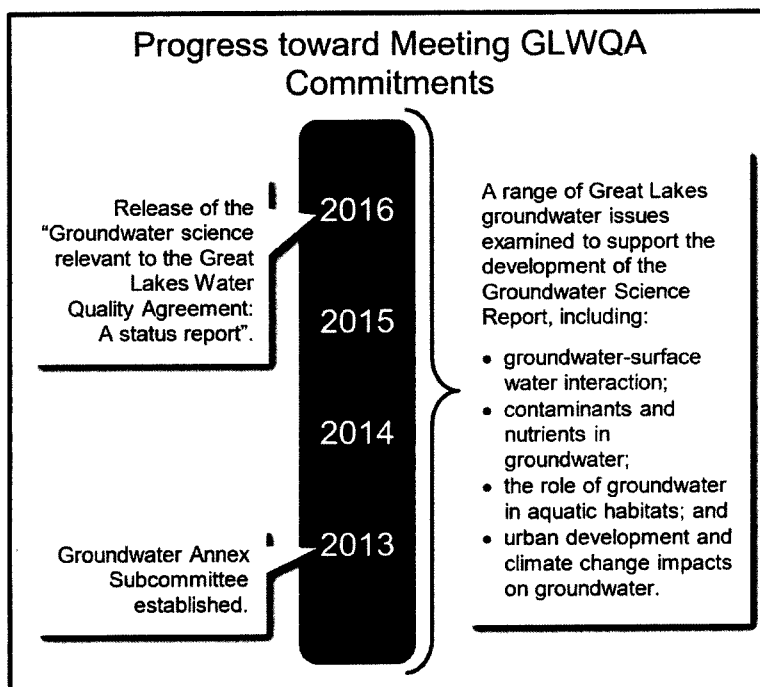
PROGRESS REPORT OF THE PARTIES

OVERVIEW

Understanding the extent of the impact that groundwater has on the chemical, physical and biological integrity of the Great Lakes is important for the long-term protection of the Great Lakes. Clean groundwater can enhance surface water quality and provide a protective treatment or storage zone; however, contaminated groundwater can act as a long-term source of pollutants and can adversely affect surface water quality. For the first time, the 2012 GLWQA recognizes the interconnection between groundwater and the waters of the Great Lakes.

The 2012 GLWQA commits the United States and Canada to coordinate scientific assessments of groundwater, in order to better understand how groundwater affects surface water quality and quantity, to coordinate groundwater management actions, and to protect and manage groundwater-related stresses affecting the waters of the Great Lakes.

As a first step in this process, the United States and Canada released a report on the relevant and available groundwater science in June 2016.



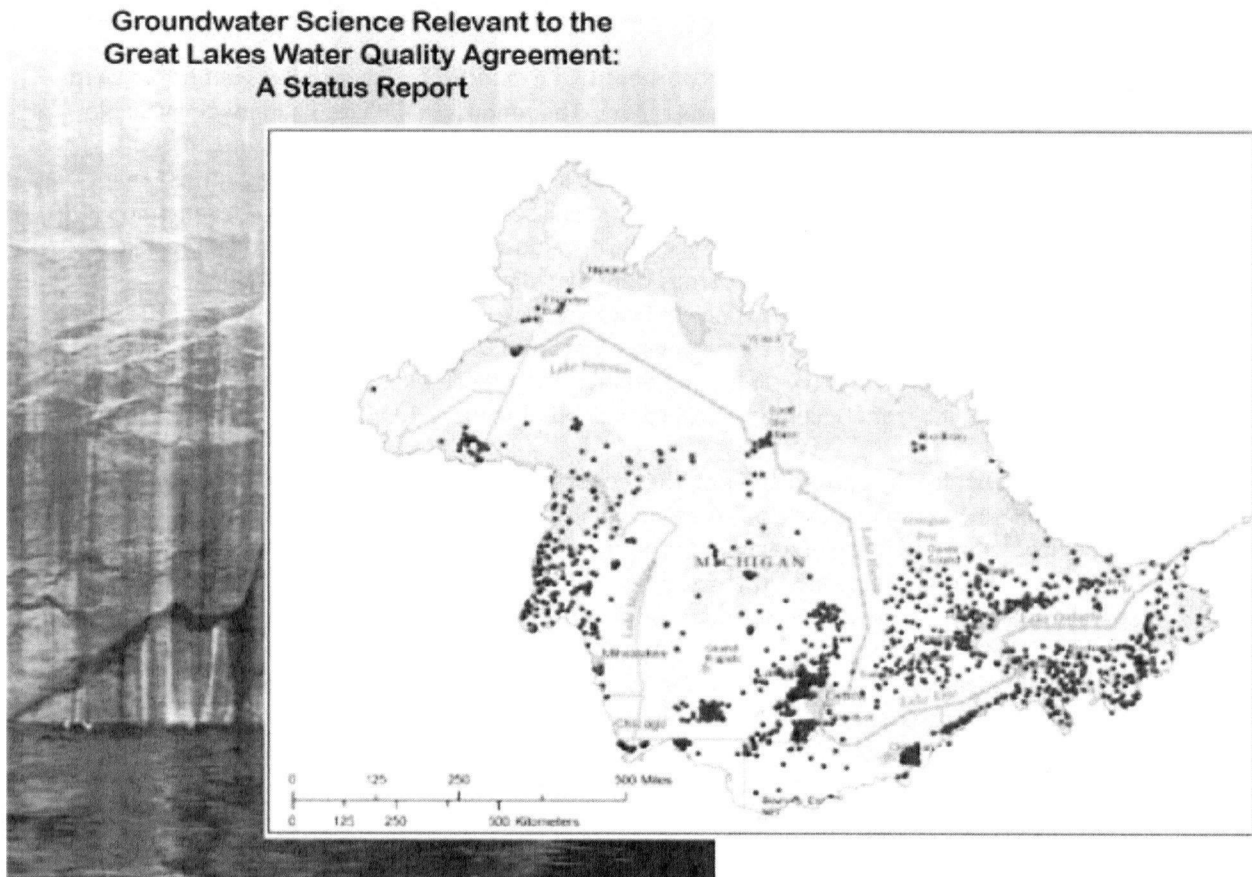
The implementation of this Annex is supported by the Groundwater Annex Subcommittee, co-led by the United States Geological Survey and Environment and Climate Canada. Organizations on the Subcommittee include: **United States Geological Survey**, Michigan Department of Environmental Quality (Office of the Great Lakes), Ohio Environmental Protection Agency, Wisconsin Department of Natural Resources, **Environment and Climate Change Canada**, Conservation Ontario, and Ontario Ministry of the Environment and Climate Change.

Binational Actions Taken

By 2015, publish a report on the relevant and available groundwater science.

- The Parties led the development of a report entitled *Groundwater Science Relevant to the Great Lakes Water Quality Agreement: A status report*. The report was finalized and made available on <https://binational.net/2015/12/03/groundwater-science/> in June 2016. (Figure 14 depicts the cover, and a map from the report showing the locations of monitoring wells in the Great Lakes basin with publicly available water quality analyses.) This report on the relevant and available Great Lakes groundwater science was developed through extensive collaboration among experts in a variety of subject areas from Canadian and United States federal departments and agencies, the Province of Ontario, state agencies (Michigan Office of the Great Lakes, Ohio Environmental Protection Agency, Wisconsin Department of Natural Resources), Conservation Authorities, universities, and others. The report takes into account public comments received from December 2015 to the end of January 2016.
- The report provides the current state of science on groundwater and its relation to Great Lakes water quality by examining various issues including: 1) the importance of groundwater-surface water interaction and interconnection; 2) contaminants and excessive nutrients in groundwater; 3) the influence of groundwater in providing aquatic habitats with a focus on Great Lakes nearshore areas, streams, and wetlands; and 4) the influence of urban development and climate change on groundwater quantity and quality. The Report also summarizes priorities for future groundwater science. This report provides a better basis and understanding of the issue of groundwater in the Great Lakes and its influence on the quality of the waters of the Great Lakes, helps assess whether groundwater improves or adversely impacts Great Lakes water quality, and supports future groundwater science and management actions.

Figure 14 – Locations of Monitoring Wells in the Great Lakes Basin with Publicly Available Water Quality Analyses.



Identifying priorities for science activities and actions for groundwater management, protection, and remediation; and

Coordinating binational groundwater activities under the GLWQA with domestic groundwater programs to assess, protect and manage groundwater impacting the Waters of the Great Lakes.

- Information from the Groundwater Science Report will be used to draft the 2017-2019 Binational Groundwater Priorities for Science and Action, which will be presented for public input at the Great Lakes Public Forum in October 2016.
- Consultations with other GLWQA Annex Subcommittees is underway to inform these 2017-2019 Binational Priorities; to determine if there needs to be a focus on coordinating specific binational groundwater activities; and, to determine the need for surveillance of groundwater quality for priority areas.

- The United States and Canada, supported by a binational group of groundwater scientists, have initiated the development of a State of the Great Lakes Groundwater Indicator. Currently, nitrate and chloride data from groundwater monitoring networks in the Great Lakes basin are being examined to assess the overall environmental status of groundwater quality and help measure progress towards the 2012 GLWQA's Article 3, General Objective (viii), "be free from the harmful impact of contaminated groundwater."

Domestic Actions Taken



Identifying groundwater impacts on the chemical, physical and biological integrity of the Waters of the Great Lakes.

- The United States Geological Survey is continuing studies of selected areas of the Great Lakes basin to evaluate the effects of land use and flow path on groundwater quality which, in turn, impact the waters of the Great Lakes as groundwater interacts with surface water.
- The State of Michigan has developed a water withdrawal assessment tool that evaluates the effect of large water withdrawals, including groundwater, on fish habitat in streams. The assessment tool has been used in Michigan for several years and is being evaluated by a few other Great Lakes states for possible implementation. Understanding the effects of groundwater withdrawal on stream habitat is an important consideration under the 2012 GLWQA.
- Researchers at Ohio State University have recently begun a project entitled *Quantifying the effects of surface water-groundwater interaction on dissolved phosphorus loads to Lake Erie*. The results of this research should help clarify the potential for groundwater discharge to streams and lakes adding to already identified surface water sources of phosphorus.



Assessing information gaps and science needs related to groundwater to protect the quality of Waters of the Great Lakes.

- In March 2015, the Ontario Geological Survey and Geological Survey of Canada hosted a Groundwater Geoscience Knowledge GAP Analysis session for southern Ontario clients to seek input at the planning phase of several large Ontario Geological Survey and Geological Survey of Canada collaborative mapping initiatives, and to discuss the future of provincial government data management. Session participants identified 30 individual groundwater geoscience knowledge gaps, which fell into seven categories including: i) communications, ii) standards and protocols, iii) water quality and geochemistry, iv) surface and groundwater interaction, v) geology and hydrogeology, vi) climate change, and vii) data management and dissemination. The Ontario Geological Survey has taken significant steps to address many of the knowledge gaps brought forward at the session, some of which are described at <http://geoscan.nrcan.gc.ca> (<http://geoscan.nrcan.gc.ca/starweb/geoscan/servlet.starweb?path=geoscan/fulle.web&search1=R=297736>).

Identifying groundwater impacts on the chemical, physical and biological integrity of the Waters of the Great Lakes.

- The Ontario Geological Survey continues to improve understanding of the data and information needed to assess the impacts of groundwater on the waters of the Great Lakes. A water quality database, created through the Ontario Geological Survey's ambient groundwater geochemistry project, is being evaluated for potential use in the development of a groundwater indicator under the guidance of the Science Annex Subcommittee.
- Through the Lake Simcoe / Southeastern Georgian Bay Clean-up Fund, Environment and Climate Change Canada is currently assessing the role of groundwater as a source of nutrients (phosphorus and reactive nitrogen) to surface waters of Southeastern Georgian Bay and the Nottawasaga River.

2016

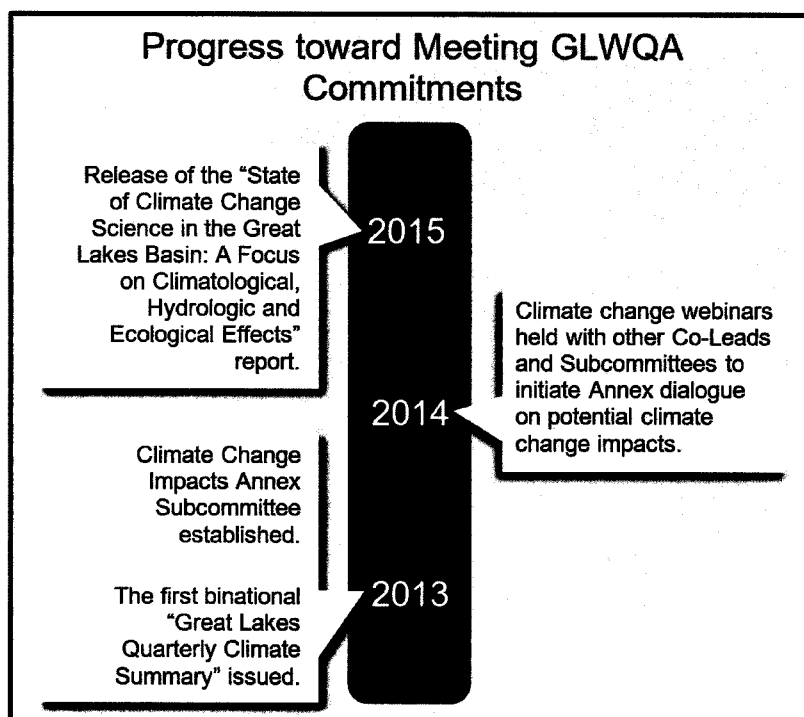
CLIMATE CHANGE IMPACTS ANNEX

PROGRESS REPORT OF THE PARTIES

OVERVIEW

Climate change impacts such as warming temperatures, changing precipitation patterns, decreased ice coverage, and alterations to water levels are being observed across the Great Lakes basin. Climate change impacts physical, chemical and biological processes such as runoff and erosion patterns, nutrient cycling, and wetland development in the Great Lakes. Understanding how climate change affects these processes now and in the future is important for making informed management decisions for the Great Lakes.

Recognizing that climate change has an impact on the quality of waters of the Great Lakes, Canada and the United States incorporated a new Annex in the 2012 GLWQA to address this issue, through which both Governments commit to coordinate efforts to identify, quantify, understand, and predict the climate change impacts on the water quality of the Great Lakes and to share information broadly with Great Lakes resource managers to proactively address these impacts.



This Annex's implementation is supported by the Climate Change Impacts Annex Subcommittee, co-led by Environment and Climate Change Canada and the National Oceanic and Atmospheric Administration. Organizations on the Subcommittee include: **Environment and Climate Change Canada**, Conservation Ontario, Ontario Ministry of Environment and Climate Change, Ontario Ministry of Natural Resources and Forestry, **United States National Oceanic and Atmospheric Administration**, Oneida Tribe of Indians of Wisconsin, United States Army Corps of Engineers,

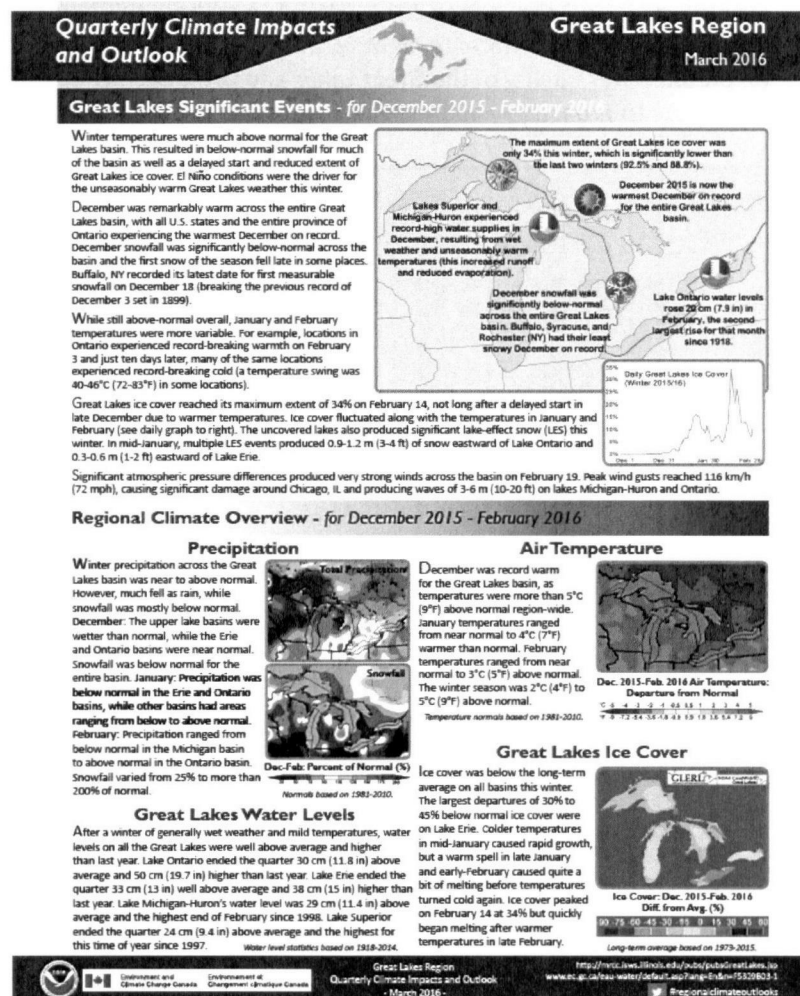
United States Environmental Protection Agency, United States Fish and Wildlife Service, United States Geological Survey, and United States National Park Service.

Binational Actions Taken

Coordinating binational climate change science activities to quantify, understand, and share information that Great Lakes resource managers need to address climate change impacts on Great Lakes water quality.

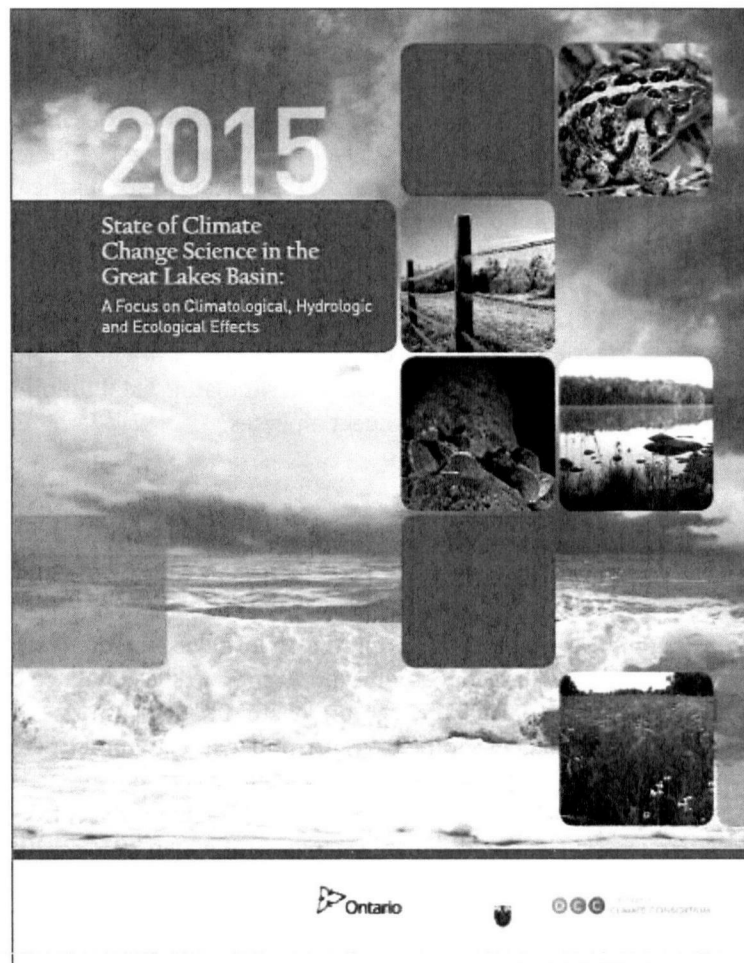
- In June 2013, Canada and the United States issued the first binational quarterly newsletter focusing on climate impacts and outlooks for the Great Lakes region. The Great Lakes Climate Quarterly newsletters provide a quick and easy-to-understand overview of the latest season's weather and water level conditions, weather and water level-related impacts, and an outlook for the upcoming quarter. These newsletters are produced by Canadian and United States experts for use by managers and practitioners at federal, state, provincial, regional, and local scales as well as stakeholders and the general public. The March 2016 edition of the Great Lakes Climate Quarterly (shown in Figure 15) along with the other editions of the Great Lakes Climate Quarterly newsletters are available at www.binational.net/category/a9/qcio-btsc.

Figure 15 – Great Lakes Climate Quarterly March 2016 Newsletter.



- A series of webinars were conducted in 2014 to present information on the best available peer-reviewed climate change science in the Great Lakes to GLWQA Annex Subcommittees, as well as other interested parties. Webinars were provided to: 1) enhance broad understanding of climate information; 2) to discuss the type of climate change information required by other Annex Subcommittees to support their activities; and 3) to help focus the work of the Climate Change Impacts Annex Subcommittee in providing tailored climate change information.
- In December 2015, a report entitled *State of Climate Change Science in the Great Lakes Basin: A Focus on Climatological, Hydrologic and Ecological Effects* was released, which synthesizes the state of climate change impacts in the Great Lakes basin and identifies key knowledge gaps. (Figure 16 depicts the cover page of the Report.) The Executive Summary and further information about the report is available at <https://binational.net/2016/09/15/state-of-climate-change-science-in-the-great-lakes-basin/>. The report, along with a companion database of all the literature reviewed for the report, were developed by the Ontario Climate Consortium, the Ontario Ministry of Natural Resources and Forestry, and McMaster University, with support from Fisheries and Oceans Canada and Environment and Climate Change Canada, and in consultation with the Climate Change Impacts Annex Subcommittee.

Figure 16 – Cover Page of the State of Climate Change Science in the Great Lakes Basin: A Focus on Climatological, Hydrologic and Ecological Effects.



Enhancing monitoring of relevant climate and Great Lakes variables to validate model predictions and to understand current climate change impacts.

- A growing ensemble of in situ measurements – including offshore eddy flux towers, buoy-based sensors, and vessel-based platforms – are being deployed through an ongoing binational collaboration known as the Great Lakes Evaporation Network. The Network is helping to reduce uncertainties in the Great Lakes water balance, providing a more robust basis for short- and long-term projections of variations in climate and lake levels, and filling a significant gap in measurements, including evaporation and water temperatures, and related meteorological data. The Network is supported through a consortium of researchers from Environment and Climate Change Canada and the National Oceanic and Atmospheric Administration, the University of Michigan, Northern Michigan University, the University of Colorado, Limno-Tech and the Great Lakes Observing System.

Developing and improving analytical tools to understand and predict climate change impacts.

- Environment and Climate Change Canada, the United States Geological Survey, and the National Oceanic and Atmospheric Administration's National Weather Service and Great Lakes Environmental Research Laboratory, have formed a binational collaboration to assess alternative methods for simulating runoff across large lake basins. The Great Lakes Runoff Inter-comparison Project is a binational collaboration aimed at assessing a variety of models currently used (or that could readily be adapted) to simulate basin-scale runoff to the Great Lakes. The first phase of the Great Lakes Runoff Inter-Comparison Project focused on Lake Michigan and involved the comparison between several very different hydrologic models in their ability to simulate the lake's tributary flows. The second phase of the Great Lakes Runoff Inter-Comparison Project focused on Lake Ontario and compared different hydrologic models in their ability to estimate Lake Ontario's direct incoming runoff. This work has improved the understanding of the differences in various models in simulating total runoff to the lakes and can help lead to improved climate change impact analyses.

Domestic Actions Taken



- The Government of Canada is committed to addressing climate change by moving toward a pan-Canadian framework for clean growth and climate change, a concrete plan that will allow Canada to meet its international commitments and transition the country into a more resilient, low-carbon economy. Canada is committed to supporting climate change mitigation and adaptation by reducing carbon pollution; putting a price on carbon; and investing in green infrastructure, public transit infrastructure, and energy efficient social infrastructure. Canada will also build on actions already taken by the provinces and territories such as the Province of Ontario's recently released Five-Year Climate Change Action Plan 2016-2020, which includes measures to reduce greenhouse gas emissions in Ontario.

Developing and improving regional scale climate models to predict climate change in the Great Lakes Basin Ecosystem at appropriate temporal and spatial scales.

Linking projected climate change outputs from regional models to chemical, physical, biological models that are specific to the Great Lakes to better understand and predict climate change impacts.

- Environment and Climate Change Canada is supporting the development of coupled atmospheric-land-ocean models for the Great Lakes-St. Lawrence River system that can be integrated with Regional Climate models to evaluate the hydrometeorological impacts of climate change.
- The Ontario Government continues to support the development of high resolution regional climate projections in support of climate impact assessments on various sectors in Ontario and the Great Lakes basin. In 2015, these regional climate projections were updated with the latest Coupled Model Intercomparison Project Phase 5 data and distributed through the following public climate data portals: <http://OntarioCCDP.ca> and <http://occp.lamps.yorku.ca/>.
- A coordinated evaluation of the impacts of climate change on the levels and flows of the St. Lawrence River between 2041-2070 (projected) and 1971-1999 is being undertaken through a collaborative of agencies including Fisheries and Oceans Canada, Hydro-Quebec, Direction de l'expertise hydrique of Quebec, OURANOS and Environment and Climate Change Canada. A major focus of this project is improving the analyses of the routing of Ottawa River flows so that Great Lakes and St. Lawrence River models can be linked, resulting in improved climate change impact projections over the entire system.

Enhancing monitoring of relevant climate and Great Lakes variables to validate model predictions and to understand current climate change impacts.

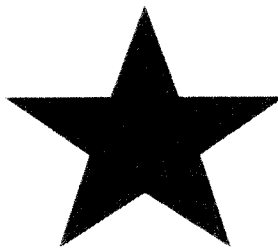
- Environment and Climate Change Canada collects data from a network of approximately 1300 surface weather and climate observing sites across the country. These sites include weather stations owned by Environment and Climate Change Canada, NAV CANADA, and National Defence, along with volunteer climate stations. The majority of these sites are automated observing platforms which report year-round, 7 days a week, 24 hours a day. Environment and Climate Change Canada in partnership with the Province of Ontario operates 440 active hydrometric gauges in the Canadian portion of the Great Lakes-St. Lawrence River basin. Environment and Climate Change Canada also supports the operation of three evaporation stations at Stannard Rock on Lake Superior, Long Point on Lake Erie, and Simcoe Island on Lake Ontario as part of the Great Lakes Evaporation Network. The information provided through these networks is critical to monitoring and predicting the impacts of climate change on the Great Lakes.

Developing and improving analytical tools to understand and predict climate change impacts.

- Environment and Climate Change Canada's Canadian Precipitation Analysis is an operational near real-time product, available since April 2011 for North America, which leverages a variety of observation and modeling information sources to estimate precipitation accumulation every six hours across Canada. The Canadian Precipitation Analysis is highly regarded due to its unique capability of capturing some of the precipitation features that are specific to the Great Lakes-St. Lawrence River region (including the effects that the lakes have on the precipitation patterns, something that is very difficult to discern with the existing precipitation gauging network). A project was initiated in 2015 to provide the foundation for extending the Canadian Precipitation Analysis back to 1983. This project will help improve hydrological forecasting and land surface estimates (including soil moisture, soil temperature and snow on the ground), leading to improved ecological prediction.

Sharing information that Great Lakes resource managers need to address climate change impacts.

- Ontario is working to establish a climate change modeling collaborative that will establish a one-window source for climate data for the purpose of ensuring open access to standardized and wide-ranging Ontario climate information. The modeling collaborative will help both public and private sectors make informed and evidence-based decisions regarding adapting to climate change and increasing resilience.



UNITED STATES

Developing and improving regional scale climate models to predict climate change in the Great Lakes Basin Ecosystem.

Linking the projected climate change outputs from the regional models to Great Lakes-specific chemical, physical, biological models.

- The National Oceanic and Atmospheric Administration's Great Lakes Environmental Research Lab brought together several different modeling and observational approaches to study climate change in the Great Lakes basin. The modeling activity consisted of further development and application of three atmosphere-lake-land regional climate models: 1) the Coupled Hydrosphere-Atmosphere Research Model (CHARM); 2) the Regional Climate Model version 4 (RegCM4) at the University of Wisconsin; and 3) the Weather Research and Forecasting Model (WRF) at the University of Maryland, as well as the development and testing of a simulation of ice and lower trophic level ecology in the form of a nutrient-phytoplankton-zooplankton-detritus model component.

Enhancing monitoring of relevant climate and Great Lakes variables to validate model predictions and to understand current climate change impacts.

- In 2013, the Lake Superior National Estuarine Research Reserve established a new Sentinel Site located in Pokegama Bay, Lake Superior. With funding support from the National Oceanic and Atmospheric Administration, this Sentinel Site included a weather/meteorological station, water quality sonde, surface elevation tables, permanent vegetation transects, geodetic vertical referencing benchmarks, and an acoustic doppler current profiler installation. This site is now recording monthly water quality sampling for nutrients and chlorophyll. The primary goal is to understand sediment movement and how sediment transfer is impacting nearshore marsh environments with increased frequency and intensity of storm events.
- The National Oceanic and Atmospheric Administration's Great Lakes Environmental Research Lab has been exploring the relationships between ice cover, lake thermal structure, and regional climate for over 30 years through development, maintenance, and analysis of historical model simulations and observations of ice cover, surface water temperature, and other variables. Weekly ice cover imaging products produced by the Canadian Ice Service started in 1973. Beginning in 1989, the United States National Ice Center produced Great Lakes ice cover charts that combined both Canadian and United States agency satellite imagery. These products are available at the Great Lakes Environmental Research Lab through the Coastwatch program (<https://coastwatch.glerl.noaa.gov/>), a nationwide National Oceanic and Atmospheric Administration program within which the Great Lakes Environmental Research Lab functions as the Great Lakes regional node.
- Currently, there is year-round monitoring infrastructure dedicated to understanding off-shore processes that impact Great Lakes ecosystem health. Beginning in Fiscal Year 2015, the National Oceanic and Atmospheric Administration's Great Lakes Environmental Research Lab (with funding support from the National Oceanic and Atmospheric Administration's Coastal Storms Program) is seeking to fill known data gaps (*i.e.*, over-water evaporation and transpiration rates and how those rates effect the overall water budget) through a two-phased approach. First, the team will deploy and manage data from vessel- and buoy-based sensors to improve understanding of over-water meteorology, evaporation, and water temperature in the Great Lakes. Second, the project will also focus on data analysis, system validation, and model assimilation to improve access to and understanding of the acquired data.

Developing and improving analytical tools to understand and predict climate change impacts.

- The National Oceanic and Atmospheric Administration's Office for Coastal Management developed and released the Lake Level Viewer (www.coast.noaa.gov/llv) for the United States portion of the Great Lakes basin in 2014. This tool helps users visualize lake level changes that range from six feet above to six feet below historical long-term average water levels in the Great Lakes, along with potential shoreline and coastal impacts. Communities can use this information to determine what preparations make the most sense in planning for water level change scenarios. Preparations might include zoning restrictions, infrastructure improvements,

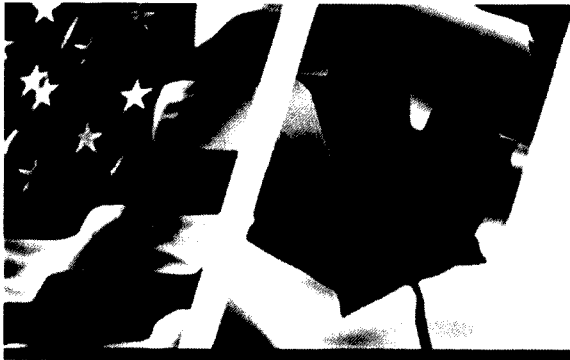
and habitat conservation. As a result of this work and product delivery, Digital Elevation Models for each lake basin and the associated topographic and bathymetric data are now available on The National Oceanic and Atmospheric Administration's Digital Coast (<https://coast.noaa.gov/digitalcoast/>).

- The National Oceanic and Atmospheric Administration's Great Lakes Environmental Research Lab developed and released a basin-wide Water Level Dashboard in 2014 (www.glerl.noaa.gov/data/dashboard/GLHCD.html). The Dashboard is a dynamic graphical interface for visualizing projected, measured, and reconstructed surface water elevations on the earth's largest lakes. This interface also reflects relationships between hydrology, climate, and water level fluctuations in the Great Lakes.

Coordinating binational climate change science activities to quantify, understand, and share information that Great Lakes resource managers need to address climate change impacts.

- The National Oceanic and Atmospheric Administration's National Center for Environmental Information produces an annual "State of the Climate" report (www.ncdc.noaa.gov/sotc). This report provides a collection of monthly summaries recapping climate-related occurrences on both a global and national scale.
- The National Park Service released Climate Change Scenario Planning Workshop Summaries for two US national parks on Lake Superior. The Isle Royale National Park report (<https://www.nps.gov/isro/learn/nature/upload/Using-Climate-Change-Scenarios-to-Explore-Management-at-ISRO.pdf>) summarized a 2013 workshop and the Apostle Island National Lakeshore report (<https://www.nps.gov/apis/learn/nature/upload/APIS-Scenario-Workshop-Report-20160104-FINAL.pdf>) summarized a 2014 workshop, which built on the process and results of the earlier session. These two-day workshops were a collaboration between the National Park Service and the Great Lakes Integrated Sciences + Assessments team (<http://glisa.umich.edu/>) from the University of Michigan. The primary objectives of the sessions were to help National Park Service leadership at local and higher levels make management and planning decisions based on up-to-date climate science and assessments of future uncertainty. The sessions were also designed to (1) assess the effectiveness of using regional-level climate science to craft local scenarios; and (2) to provide opportunities for participants to better understand how climate scenarios can be used.

2016



SCIENCE ANNEX

PROGRESS REPORT OF THE PARTIES

OVERVIEW

Science provides the foundation for management actions and policy decisions in support of meeting the objectives of the Agreement.

The 2012 GLWQA recognizes that the effective implementation of management decisions, policies and programs must be based on the best available science, research and knowledge. Throughout the 2012 GLWQA, specific science-based commitments are captured in relation to various Annexes. The Science Annex of the 2012 GLWQA commits the United States and Canada to enhancing the coordination, integration, synthesis, and assessment of science activities across all Annexes of the Agreement.



This Annex's implementation is supported by the Science Annex Subcommittee, co-led by the United States Environmental Protection Agency and Environment and Climate Change Canada. Organizations on the Subcommittee include: United States Environmental Protection Agency, United States Army Corps of Engineers, United States Geological Survey, United States National Oceanic and Atmospheric Administration, Wisconsin Department of Natural Resources, Environment and Climate Change Canada, Agriculture and Agri-Food Canada, Conservation Ontario, Fisheries and Oceans Canada, Natural Resources Canada, Ontario Ministry of Environment and Climate Change, and the Ontario Ministry of Natural Resources and Forestry.

Binational Actions Taken

Establishing and maintaining comprehensive, science-based ecosystem indicators to assess the state of the Great Lakes, to anticipate emerging threats, and to measure progress in relation to achievement of the Objectives of the Agreement.

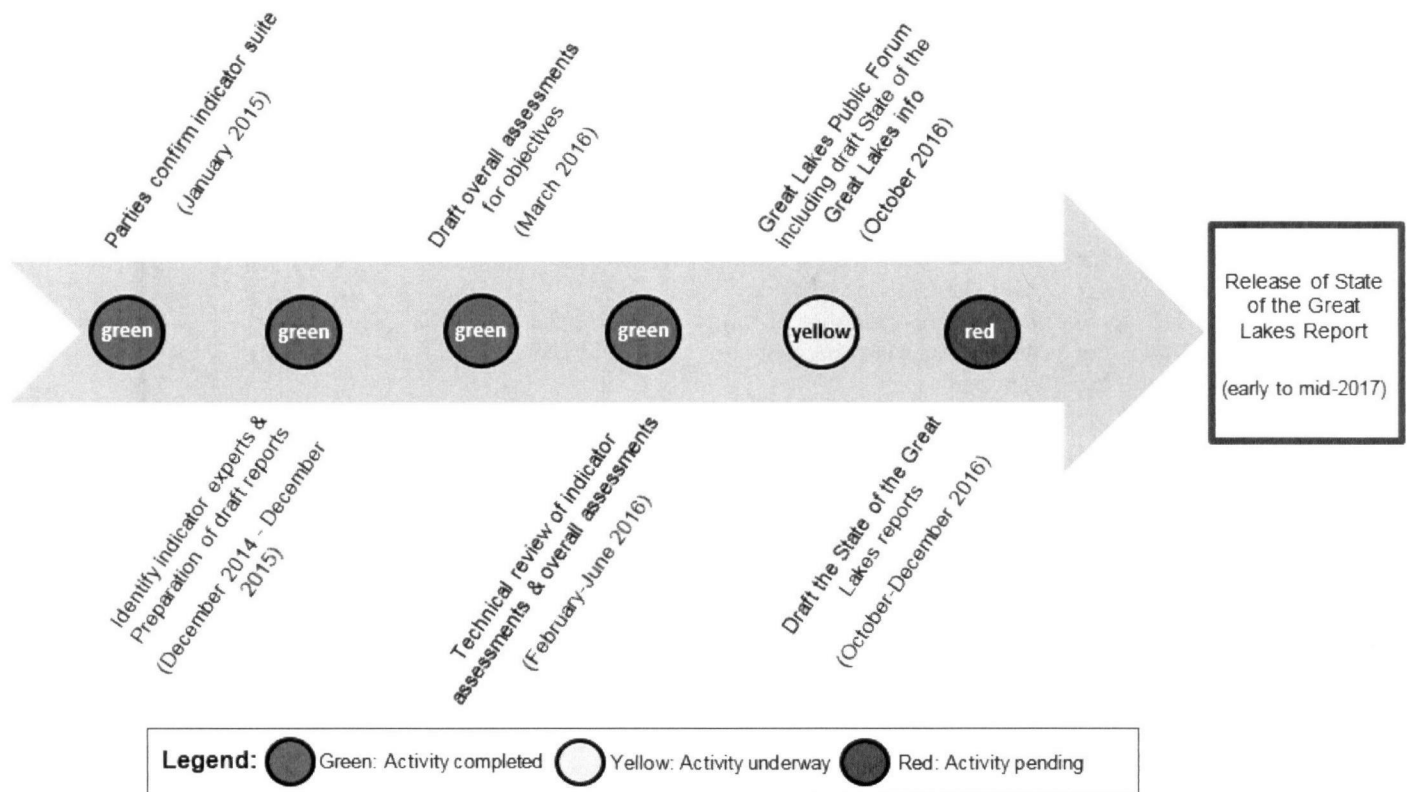
In 2016, issue a State of the Great Lakes Report describing basin-wide environmental trends and lake-specific conditions using ecosystem indicators.

- In January of 2015, the United States and Canada confirmed the suite of indicators to be used to assess water quality and the ecosystem conditions of the Great Lakes under the 2012 GLWQA. This suite of indicators builds on the State of the Lakes Ecosystem Reporting by the Parties, which has been ongoing since 1994.
- The indicator suite includes nine indicators, one for each of the General Objectives of the 2012 GLWQA. The nine indicators are supported by 43 sub-indicators. Figure 17 depicts these indicators and sub-indicators.
- Over 100 Great Lakes experts representing federal, provincial, state and local governments, as well as academia and non-governmental organizations, have engaged in assembling and assessing relevant data, and reporting against the indicator suite.
- In 2016, draft assessments for the indicators were developed and reviewed by subject matter experts. These draft assessments will be presented at the Great Lakes Public Forum in October 2016 for public comment. A final State of the Great Lakes report, describing basin-wide and lake-specific environmental trends and conditions using the ecosystem indicators, is targeted for release in 2017 (as depicted in Figure 18).

Figure 17 – Indicators and Sub-Indicators for Assessing the State of the Great Lakes.

1. Drinking Water
2. Beaches
3. Fish Consumption
4. Toxic Chemicals
 - Toxic Chemical Concentrations (open water)
 - Toxic Chemicals in Great Lakes Whole Fish
 - Toxic Chemicals in Great Lakes Herring Gull Eggs
 - Toxic Chemicals in Sediment
 - Atmospheric Deposition of Toxic Chemicals
 - Water Quality in Tributaries
5. Habitat & Species
 - Coastal Wetland Invertebrates
 - Coastal Wetland Fish
 - Coastal Wetland Plants
 - Coastal Wetland Amphibians
 - Coastal Wetland Birds
 - Coastal Wetlands: Extent and Composition
 - Aquatic Habitat Connectivity
 - Fish Eating and Colonial Nesting Waterbirds
 - Phytoplankton (open water)
 - Zooplankton (open water)
 - Benthos (open water)
 - Diporeia (open water)
 - Preyfish (open water)
 - Lake Trout
 - Walleye
 - Lake Sturgeon
6. Nutrients & Algae
 - Nutrients in Lakes (open water)
 - Harmful Algal Blooms
 - Cladophora
7. Invasive Species
 - Aquatic Invasive Species
 - Sea Lamprey
 - Dreissenid Mussels
 - Terrestrial Invasive Species
8. Groundwater
9. Watershed & Climate Impacts
 - Water Levels
 - Surface Water Temperature
 - Ice Cover
 - Precipitation Events
 - Forest Cover
 - Land Cover
 - Tributary Flashiness
 - Hardened Shorelines

Figure 18 – State of the Great Lakes Report Timeline.



Implementing a cooperative science and monitoring initiative for each of the Great Lakes on a five-year rotational basis.

- The Cooperative Science and Monitoring Initiative (CSMI) was developed to binationally coordinate the research and monitoring activities being undertaken in the Great Lakes basin (such as coordinating the movement of research vessels like the Lake Guardian and Limnos pictured in Figure 19) and to ensure that the necessary science is efficiently provided to support Great Lakes decision-making and management actions. Each year, as part of the CSMI, U.S. and Canadian organizations assess one of the Great Lakes during that lake's intensive CSMI field year. This emphasis on one Great Lake per year allows for enhanced coordination of research and monitoring activities, as well as the cooperation on specific science assessments, in that particular Great Lake during that year. This intensive CSMI field year follows a five-year rotating cycle (as shown in Figure 20).
- The CSMI process includes the following steps leading up to and following the intensive field year: 1) identification of research and monitoring needs and other science priorities to assess threats to Great Lakes water quality and support management actions; 2) planning, which involves working with governmental and academic scientists to develop and coordinate specific research activities for the Great Lake in question; 3) undertaking the coordinated monitoring

and cooperative science assessments (*i.e.*, intensive field year); 4) laboratory analysis; 5) data analysis and reporting; and 6) final report and communicating out.

- Some examples of lake-specific cooperative science include:
 - An assessment in Lake Ontario in 2013, of the lower food web and the movement of nutrients and energy from nearshore-to-offshore waters, including nutrient loadings.
 - An assessment in Lake Erie in 2014 of Dreissenid mussel populations, nutrient loadings from rivers and western basin sediments, and development of a phosphorus mass balance model for the western and central basin.
 - An assessment of nutrient and contaminant loads to Lake Michigan in 2015 and an investigation of the movement of nutrients and energy from nearshore-to-offshore waters.
 - An assessment in Lake Superior in 2016 of chemical emission reduction actions and an evaluation of the health of the lower food web and important fish communities.

Figure 19 – Research Efforts on the Great Lakes.

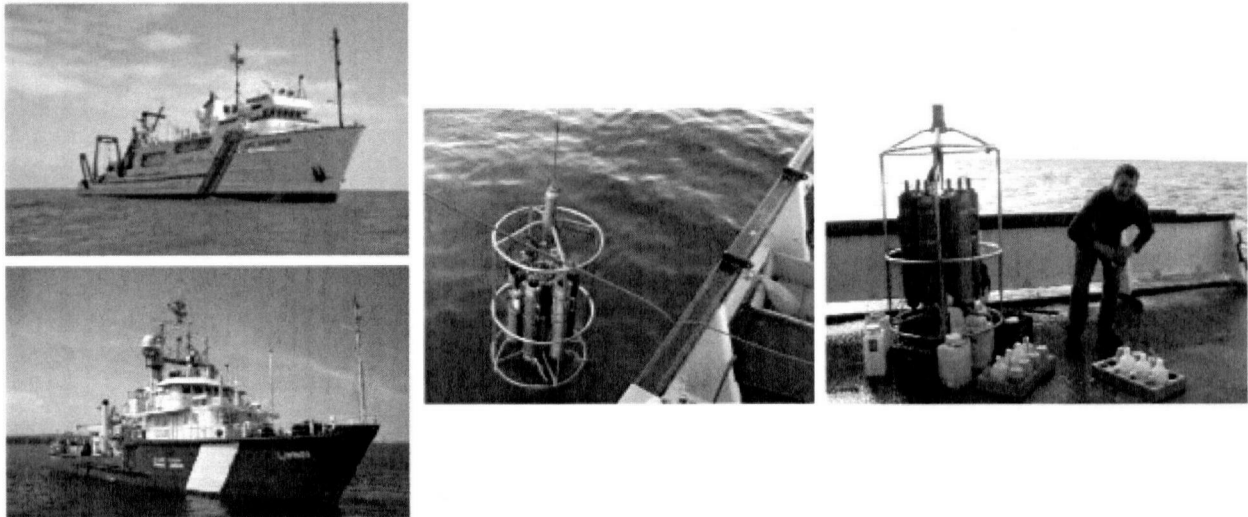
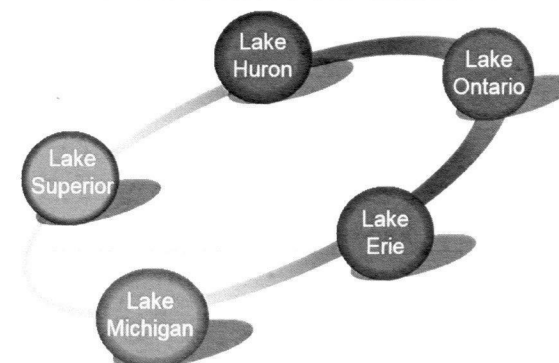


Figure 20 – The Cooperative Science and Monitoring Initiative Rotational Cycle.

CSMI Steps	2013	2014	2015	2016	2017	2018
<i>Identification of research and monitoring needs and other science priorities</i>	Lake Michigan science needs	Lake Superior science needs	Lake Huron science needs	Lake Ontario science needs	Lake Erie science needs	Lake Michigan science needs
<i>Planning</i>	Lake Erie planning	Lake Michigan planning	Lake Superior planning	Lake Huron planning	Lake Ontario planning	Lake Erie planning
<i>Intensive field year</i>	Lake Ontario field year	Lake Erie field year	Lake Michigan field year	Lake Superior field year	Lake Huron field year	Lake Ontario field year
<i>Laboratory analysis</i>	Lake Huron lab analysis	Lake Ontario lab analysis	Lake Erie lab analysis	Lake Michigan lab analysis	Lake Superior lab analysis	Lake Huron lab analysis
<i>Data analysis and reporting</i>	Lake Superior data analysis	Lake Huron data analysis	Lake Ontario data analysis	Lake Erie data analysis	Lake Michigan data analysis	Lake Superior data analysis
<i>Reporting and communicating out</i>	Lake Michigan report/outreach	Lake Superior report/outreach	Lake Huron report/outreach	Lake Ontario report/outreach	Lake Erie report/outreach	Lake Michigan report/outreach



Facilitating information management and sharing to improve knowledge, accessibility and exchange of relevant Great Lakes information.

- Data and information management and sharing efforts to support implementation of relevant 2012 GLWQA commitments are being examined. An initial examination was undertaken to understand the data and information management and sharing needs across all of the Annexes of the GLWQA. Based on this information and discussions at the Great Lakes Executive Committee meetings, the Science Annex Subcommittee will be examining existing Great Lakes-related distributed data and information access systems and platforms and their application to a specific pilot project on a priority area such as the Lake Erie phosphorus and/or nearshore issue.

Identifying science priorities, taking into account recommendations of the International Joint Commission.

Undertaking a review of available scientific information to inform management actions and policy development.

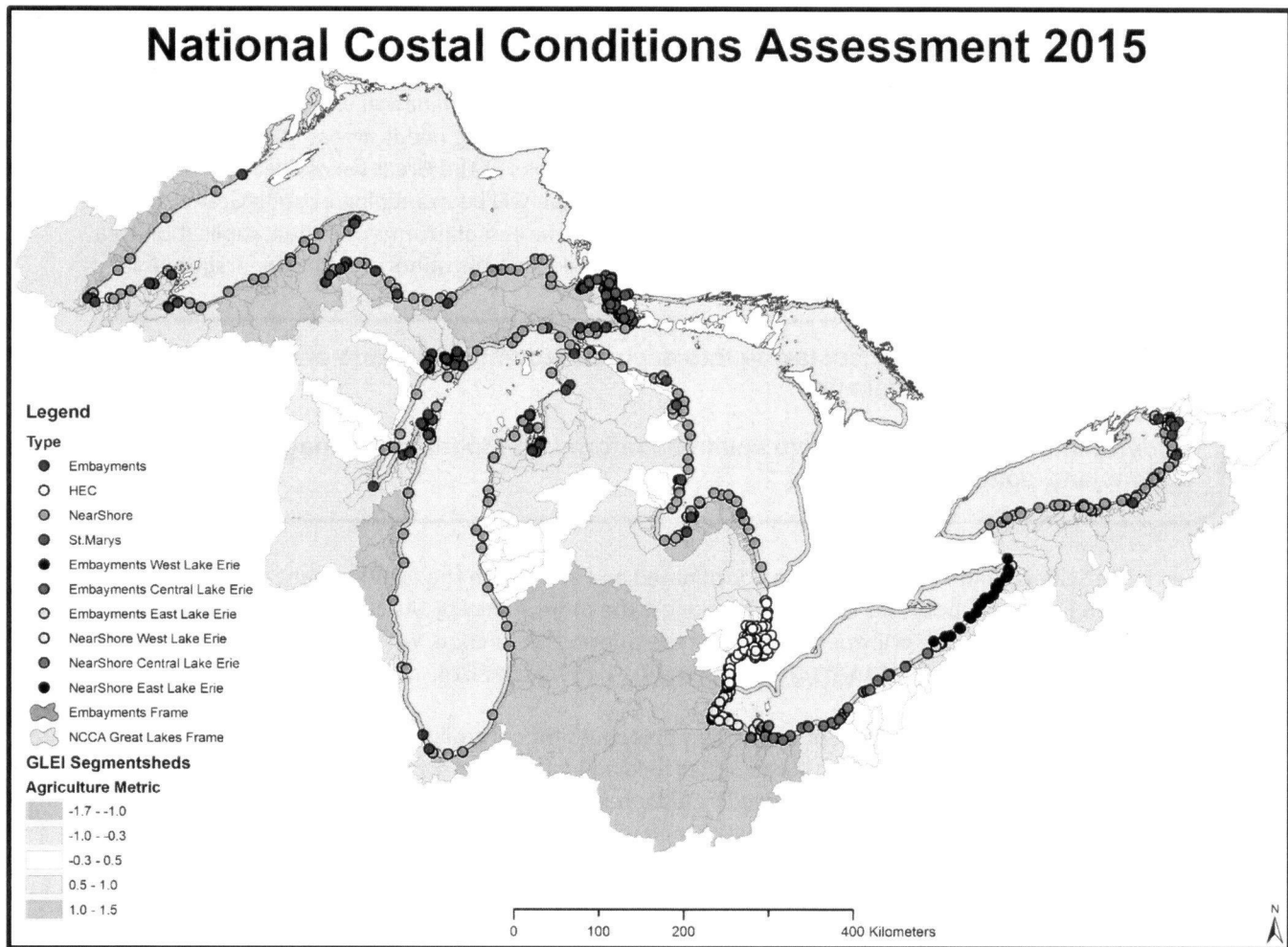
- The Science Annex Subcommittee coordinated and assisted in the development of the 2014-2016 binational priorities for science amongst the other Annexes. As called for in Article 5 of the 2012 GLWQA, these priorities, along with the priorities for action, were posted on binational.net (www.binational.net/2014/03/20/psa-pasa-2014) in March 2014.
- In support of the development of nutrient objectives for controlling nuisance *Cladophora* in the Great Lakes, Canada and the United States held a binational workshop on January 28-26, 2016 to determine the state of knowledge of *Cladophora* from the perspectives of the entire Great Lakes basin, from that of individual lakes, and with respect to areas within each lake where *Cladophora* is perceived to be a significant local problem. The findings of the workshop will help guide a strategy for proposing nutrient reduction targets that will control *Cladophora*.

Domestic Actions Taken



- Between 2013 and 2016, the United States Environmental Protection Agency's Great Lakes National Program Office used Great Lakes Restoration Initiative (GLRI) funding to maintain and enhance its Long-Term Great Lakes Monitoring Programs. These programs include the Open Lake Water Quality Surveys, the Integrated Atmospheric and Deposition Network, and the Great Lakes Fish Monitoring and Surveillance Program.
- Between 2013 and 2016, GLRI funding helped supplement the Environmental Protection Agency's implementation of its Great Lakes National Coastal Condition Assessment. The assessment is undertaken every five years to determine the condition of the nation's coastal waters as well as to evaluate the importance of key stressors such as nutrients and pathogens (as shown in Figure 21). The Great Lakes assessment included monitoring 100 sites per Great Lake, including the connecting channels (Huron-Erie Corridor and St. Marys River).

Figure 21 – United States Environmental Protection Agency's Great Lakes National Coastal Condition Assessment.



- In support of the Nutrient and Lakewide Management Annexes, and with the support of GLRI funding, the Environmental Protection Agency and the United States Geological Survey assessed and improved their understanding of the impacts of agriculture and agricultural practices, climate change, and land use change on the timing and magnitude of delivery of nutrients and sediments to the Great Lakes.
- In 2015, the United States National Oceanic and Atmospheric Administration's Great Lakes Environmental Research Laboratory partnered with the University of Michigan's Cooperative Institute for Limnology and Ecosystems Research and used GLRI funding to sample eight sites throughout the western basin of Lake Erie and four sites in Lake Huron's Saginaw Bay. The sampling was done to assess the impact of land use on algal bloom development. Measurements of bloom toxicity have proven invaluable to regional stakeholders and the Nutrients Annex Task Team.

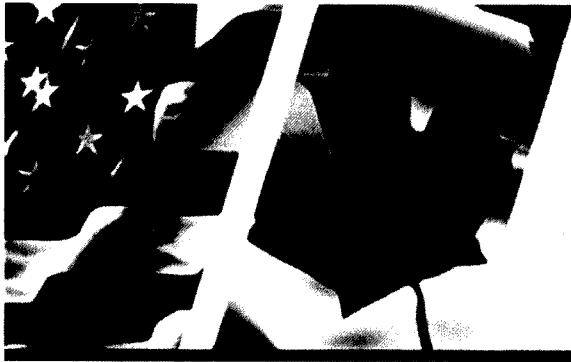
- In an effort to build broader research partnerships, the Environmental Protection Agency's Great Lakes National Program Office has made the 180-foot R/V Lake Guardian available to researchers to provide sampling access to the open waters of the Great Lakes.
- With the support of GLRI funding, an initial coastal wetland classification assessment was completed that will be used by the Habitat and Species Annex Subcommittee to prioritize coastal wetland work.



• The Government of Canada is committed to Open Science and Open Data, which includes performing science in a more open and collaborative manner and maximizing accessibility to federal publications and data. Through the Action Plan on Open Government, Canada is pledging to expand its open government activities to broaden access to data and information, ensure transparency and accountability, and strengthen citizen engagement in the activities of government and in the democratic process. Data collected by Environment and Climate Change Canada in the Great Lakes to support the implementation of the 2012 GLWQA, is being prepared for release on the Government of Canada's Open Data Portal and datasets are being piloted through the process to validate and ensure future sustainability and openness of the approach.

- The Freshwater Quality Monitoring and Surveillance Program (FWQMS) of Environment and Climate Change Canada conducts water quality surveys of nutrients and contaminants in water, sediment and aquatic biota in the open lakes, tributaries, Areas of Concern and in the connecting channels. This long-term monitoring program monitors legacy compounds (such as PCBs, PAHs and organochlorine pesticides) and, more recently, also includes monitoring of emerging compounds (such as organosiloxanes, brominated and organophosphate flame retardants and Bisphenol A).
- The Environment and Climate Change Canada Chemicals Management Plan (CMP) Monitoring and Surveillance in the Great Lakes Basin (GLB) for air and precipitation monitors for both legacy and emerging compounds (CMP priority substances and others). Combining air (GLB), precipitation (GLB) and water (FWQMS) concentrations of these substances, atmospheric deposition can be estimated. CMP Monitoring and Surveillance also include monitoring of these substances in biota (fish and birds etc.), sediments and waste water treatment plants (biosolids, effluents, etc.). The CMP multi-media monitoring effort advances the understanding of Chemicals of Mutual Concern (CMC) inputs and pathways in the Great Lakes region. This effort also provides essential risk assessment information required for future identification of additional CMCs.
- In 2014, Environment and Climate Change Canada collaborated in a joint study with the Ontario Ministry of the Environment and Climate Change to measure changes in herbicide concentrations in Ontario urban streams (with five of the ten urban streams selected flowing into Lake Ontario) following a cosmetic pesticides ban in 2009. Findings indicate that concentrations in the majority of the study streams decreased significantly following the cosmetic pesticides ban, decreasing from 16% to 92%, depending on the stream and herbicide.

- As part of Great Lakes Nutrient Initiative, Environment and Climate Change Canada supported the development and implementation of binational phosphorous load targets in Lake Erie by conducting intensive open lake, nearshore and tributary monitoring; and modeling and research on nuisance and harmful algal blooms.
- Environment and Climate Change Canada is also conducting nutrient loading research in Georgian Bay to identify adverse impacts such as the generation of harmful algal blooms and hypoxia in some nearshore regions.
- In March 2013, a Canadian workshop was organized to support identifying possible science priorities that Canada could put forward for the first three years under the 2012 GLWQA, pursuant to the development of the binational priorities for science called for in Article 5 of the 2012 GLWQA.
- Within Environment and Climate Change Canada, two Great Lakes Science Days have been held in an effort to share information on priorities, progress and emerging issues, and also to encourage continued collaboration between Great Lakes scientists, researchers and program teams within the department.



SUMMARY AND CONCLUDING REMARKS

2016

PROGRESS REPORT OF THE PARTIES

Under the 2012 Great Lakes Water Quality Agreement, Canada and the United States have been working together to restore and maintain the chemical, physical, and biological integrity of the waters of the Great Lakes.

This report outlines the significant progress achieved over the first three years of the implementation of the Agreement's Articles and ten Annexes. The accomplishments demonstrate the Parties' efforts to protect this vital treasure and fulfill their promises made under the Agreement.

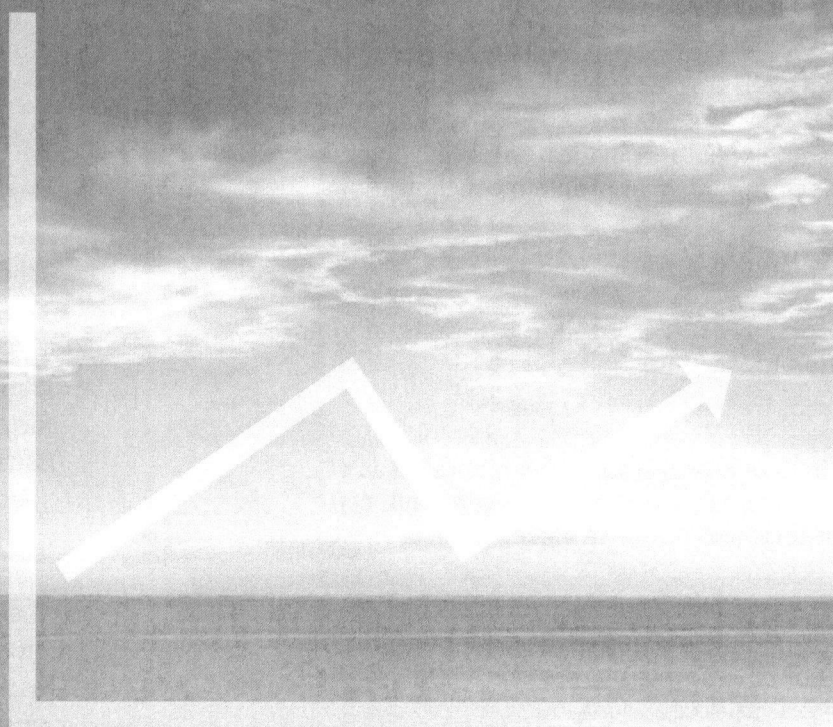
As the first Progress Report of the Parties under the 2012 Great Lakes Water Quality Agreement, there is room for improvement and the Parties, using information from the forthcoming International Joint Commission's Assessment of Progress Report, will endeavour to improve the next Progress Report of the Parties—to be issued in 2019.

Canada and the United States look forward to continuing the vital work under the GLWQA, in a spirit of consultation and collaboration with state and provincial governments, tribal governments, First Nations, Métis, municipal governments, watershed management agencies, other local public agencies, and the general public.

STATE OF THE GREAT LAKES 2017

HIGHLIGHTS REPORT

An overview of the status and trends of the Great Lakes ecosystem



WHAT ARE THE GREAT LAKES INDICATORS TELLING US?

CAN WE DRINK THE WATER?

YES The Great Lakes remain a source of high quality drinking water.

CAN WE SWIM AT THE BEACHES?

YES But some beaches are unsafe for swimming some of the time due to bacterial contamination.

CAN WE EAT THE FISH?

YES But contaminants in fish require limits to be placed on the amount of fish consumed in order to safeguard human health.

ARE THE LAKES FREE FROM POLLUTANTS AT LEVELS HARMFUL TO HUMAN HEALTH AND THE ENVIRONMENT?

GENERALLY, YES But some pollutants in local areas, including in designated Areas of Concern, remain at problem concentrations.

ARE THE LAKES SUPPORTING HEALTHY WETLANDS AND OTHER HABITATS FOR NATIVE SPECIES?

IN SOME INSTANCES YES, AND IN OTHERS NO Results vary significantly from location to location.

ARE THE LAKES FREE FROM EXCESS NUTRIENTS?

NO Nutrient loadings in Lake Erie and some nearshore areas of Lakes Huron, Michigan and Ontario are causing severe impacts due to the formation of toxic and nuisance algae.

ARE WE WINNING THE BATTLE AGAINST AQUATIC INVASIVE SPECIES?

NO While the introduction of new non-native species has declined, the spread and impacts of aquatic invasive species already in the lakes continues.

IS GROUNDWATER NEGATIVELY AFFECTING THE WATER QUALITY OF THE LAKES?

GENERALLY, NO But some localized areas of contamination exist.

ARE LAND USE CHANGES IMPACTING THE LAKES?

YES Growth, development, and land-use activities stress the waters of the Great Lakes.

**OVERALL,
THE GREAT LAKES
ARE ASSESSED
AS FAIR AND
UNCHANGING.**

While progress to restore and protect the Great Lakes has been made, including the reduction of toxic chemicals, we are still facing challenges with issues such as invasive species and nutrients.

In addition, the ecosystem is large and complex and it can take years to respond to restoration activities and policy changes.



Why are the Great Lakes Important?

The Great Lakes contain one fifth of the world's fresh surface water supply and are one of the most ecologically diverse ecosystems on earth. They provide drinking water to tens of millions of Canadians and Americans and are important to the economies of both Canada and the United States, supporting manufacturing, transportation, farming, tourism, recreation, clean energy production, and other forms of economic growth.

How are Governments Working Together to Protect the Great Lakes?

2017 marks the 45th anniversary of the signing of the Great Lakes Water Quality Agreement by the Governments of Canada and the United States. The Agreement commits both countries to working cooperatively to restore and protect the water quality and aquatic ecosystem health of the Great Lakes. Through the Agreement, the Governments of Canada and the United States engage the provincial and state governments of Ontario, Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania, and Wisconsin, Tribes, First Nations, Métis, municipal governments, watershed management agencies, other local public agencies, industry and the public in actions to ensure that the Great Lakes remain an important and vibrant natural resource for the benefit and enjoyment of this generation and those to come.

How is the Health of the Great Lakes Assessed?

The Governments of Canada and the United States, together with their many partners in protecting the Great Lakes, have agreed on a set of 9 indicators of ecosystem health. These indicators are in turn supported by 44 sub-indicators, measuring such things as concentrations of contaminants in water and fish tissue, changes in the quality and abundance of wetland habitat, and the introduction and spread of invasive species. To create this report, more than 180 government and non-government Great Lakes scientists and other experts worked to assemble available data to populate the suite of sub-indicators

and to agree on what the indicators are telling us. Each indicator was assessed in relation to both status and trend. Status is defined as Poor, Fair or Good. Trend is defined as Deteriorating, Unchanging or Improving.

How is the Assessment of the Great Lakes Used?

Assessments of the Great Lakes help Governments to identify current, new and emerging challenges to Great Lakes water quality and ecosystem health. Assessments also help Governments to evaluate the effectiveness of programs and policies in place to address challenges, and help inform and engage others. We all have a role to play in helping to restore and protect the Great Lakes.

Overall Assessments of the Nine Great Lakes Indicators of Ecosystem Health

Great Lakes Indicator	Status and Trend
Drinking Water	Status: Good Trend: Unchanging
Beaches	Status: Fair to Good Trend: Unchanging
Fish Consumption	Status: Fair Trend: Unchanging
Toxic Chemicals	Status: Fair Trend: Unchanging to Improving
Habitats and Species	Status: Fair Trend: Unchanging
Nutrients and Algae	Status: Fair Trend: Unchanging to Deteriorating
Invasive Species	Status: Poor Trend: Deteriorating
Groundwater Quality	Status: Fair Trend: Undetermined
Watershed Impacts and Climate Trends	<u>Watershed Impacts:</u> Status: Fair Trend: Unchanging
	<u>Climate Trends:</u>
	No Overall Assessment

Drinking Water

Status: Good Trend: Unchanging

Nearly 30 million Americans and the majority of the 11 million Canadians living in the basin get their drinking water from the Great Lakes.



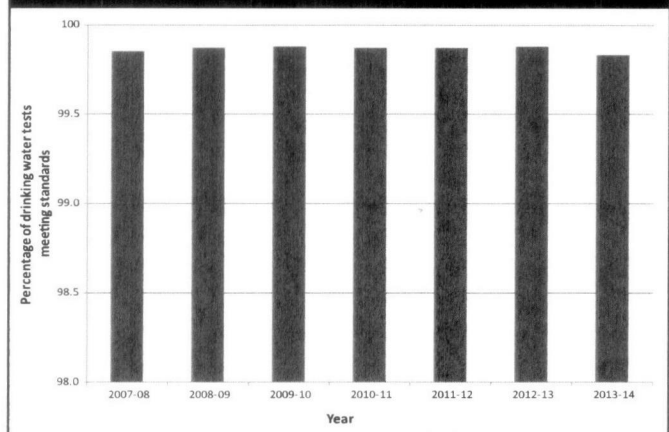
The 2012 Great Lakes Water Quality Agreement states that *"the Waters of the Great Lakes should be a source of safe, high-quality drinking water"*

Assessment Highlights

The Drinking Water indicator shows that the status of treated drinking water in both Canada and the U.S. is **Good** and the trend is **Unchanging** since the last report in 2011. This shows that the Great Lakes continue to be a high-quality source of drinking water; however, as with all source waters, water from the Great Lakes must be treated to make it safe to drink.

Ontario and U.S. state agencies have different ways of analyzing and reporting on the quality of treated drinking water, however, both compare microbial, radiological and chemical parameters in treated drinking water to health-based standards. In the Province of Ontario, almost 60% of the population gets their drinking water from the Great Lakes and treated water tests met Ontario Drinking Water Quality Standards 99.83% - 99.88% of the time from 2007 to 2014. In the U.S., 95 - 97% of the U.S. population living within the Great Lakes Basin, or approximately 27 million people, were serviced with drinking water that met all applicable health-based drinking water quality standards from 2012 to 2014.

Percentage of Canadian Drinking Water Tests Meeting Standards



Sub-Indicators Supporting the Indicator Assessment

Sub-Indicator	Lake Superior	Lake Michigan	Lake Huron	Lake Erie	Lake Ontario
Treated Drinking Water	No lake was assessed separately Great Lakes Basin assessment is Good and Unchanging				

Status: **GOOD** **FAIR** **POOR** **UNDETERMINED**

Beaches

Status: Fair to Good Trend: Unchanging

Great Lakes beaches are enjoyed by millions of residents and tourists each year and contribute significantly to local economies; however, some beaches are closed at times due to bacterial contamination caused by overflow of sewage treatment systems, stormwater runoff and other sources.



The 2012 Great Lakes Water Quality Agreement states that *"the Waters of the Great Lakes should allow for swimming and other recreational use, unrestricted by environmental quality concerns"*

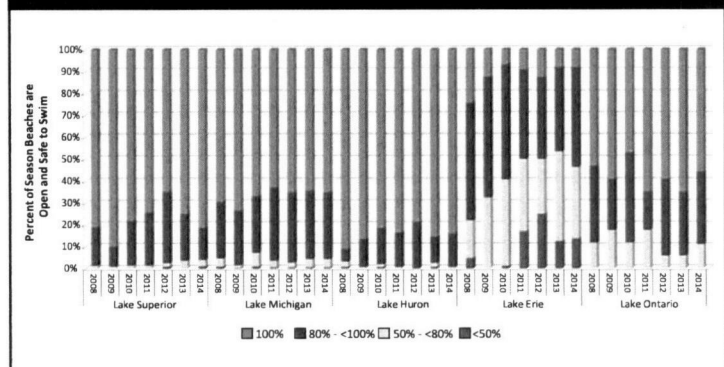
Assessment Highlights

The overall status of Beaches is **Fair to Good** and the trend is **Unchanging** since 2011. The Beaches indicator shows that many monitored beaches in the Great Lakes are safe for swimming and recreational use throughout most of the swimming season.

The U.S. and Canada use different bacterial standards or criteria to determine when a beach is unsafe for swimming or other recreational activities. The Ontario standards are more stringent and therefore Ontario often has more beach health advisories issued. Approximately 1,000 beaches along the Great Lakes shoreline are monitored for the fecal bacteria indicator *E. coli* each year. Over the 2011 to 2014 time period, the percentage of days that monitored Canadian Great Lakes beaches met Ontario bacterial standards for swimming averaged 78%. The U.S. Great Lakes beaches monitored during this same time period were open and safe for swimming 96% of the time on average. However, the status of Lake Erie beaches in Canada and the U.S. has deteriorated from the previous 2008 to 2010 reporting period. Sources of *E. coli* for all of the Great Lakes can include wastewater treatment plants,

runoff from the land after a heavy rainfall, improperly working septic systems, and even large flocks of gulls.

U.S. Great Lakes Beaches: Percent of Season Open By Lake



Sub-Indicators Supporting the Indicator Assessment

Sub-Indicator	Lake Superior	Lake Michigan	Lake Huron	Lake Erie	Lake Ontario
Beach Advisories	Unchanging	Unchanging	Unchanging	Deteriorating	Unchanging

Status: GOOD FAIR POOR UNDETERMINED

Fish Consumption

Status: Fair Trend: Unchanging

The Great Lakes support commercial, recreational and subsistence fisheries; however, some chemicals present in the Great Lakes, including PCBs, mercury and dioxins, accumulate in fish tissues and may reach concentrations which could harm human health.

The 2012 Great Lakes Water Quality Agreement states that *"the Waters of the Great Lakes should allow for human consumption of fish and wildlife unrestricted by concerns due to harmful pollutants"*

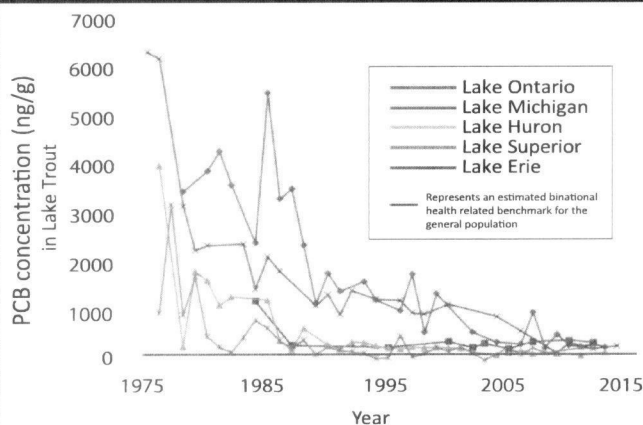
Assessment Highlights

The Fish Consumption indicator reveals that in all the Great Lakes contaminants in edible portions of fish have declined over time. However, in Lakes Erie and Huron, recent concentrations of PCBs and mercury are stable or slightly increasing. The status of contaminants in edible portions of fish is assessed as **Fair** and the trend is **Unchanging** since last reported in 2011.

Contaminants causing consumption restrictions of Great Lakes fish typically include PCBs, mercury, and dioxins. PCBs drive the majority of fish consumption advice in both the U.S. and Canada. PCB levels in edible portions of fish tissue have decreased by 90% in some cases, but are still above consumption benchmarks. Mercury levels have generally declined over the last four decades and, depending on the fish species and lake, are lower than most fish consumption advisory benchmarks. However, in Lakes Erie and Huron, PCBs and mercury have remained stable or are slightly increasing. Non-legacy contaminants, such as Perfluorooctanesulfonic acid or PFOS (a stain repellent), continue to be a monitoring priority and will be included in future State of the Great Lakes reporting as necessary. Additional stressors such as warming waters and invasive

species will likely continue to complicate the cycling of contaminants in the Great Lakes and may impact the levels of contaminants in fish.

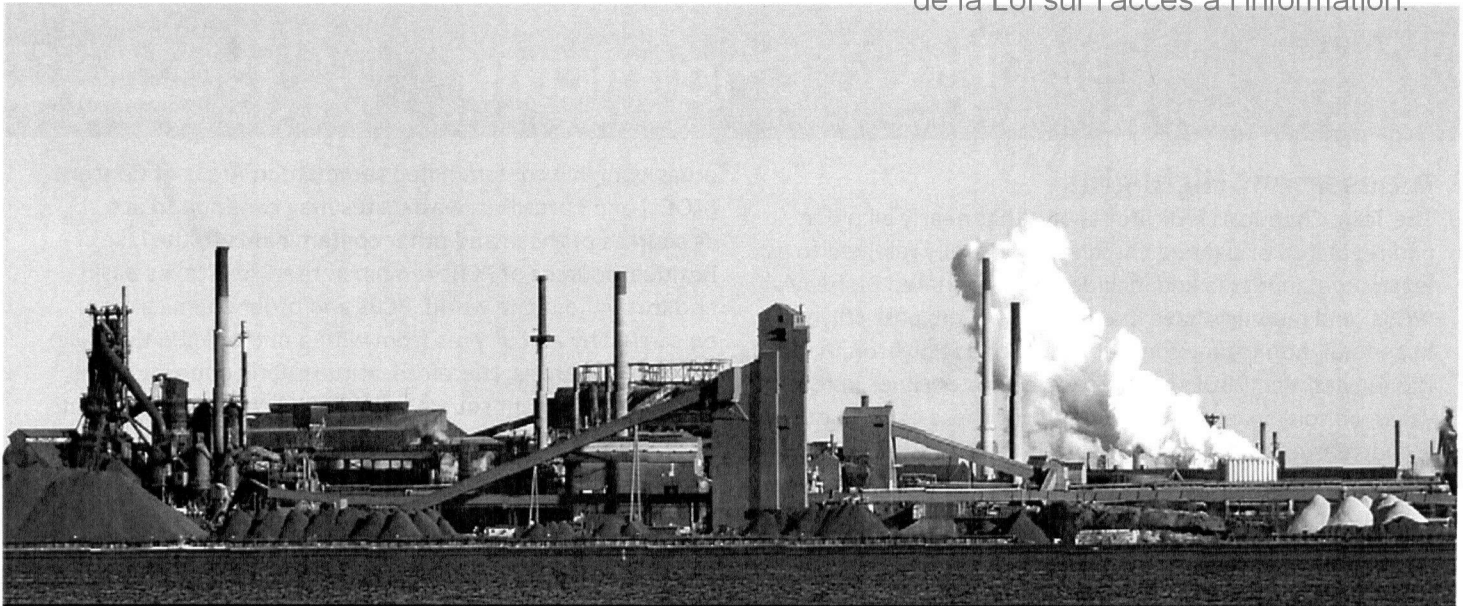
PCBs in Edible Fish Tissue Have Declined But Are Still Above Guidelines



Sub-Indicators Supporting the Indicator Assessment

Sub-Indicator	Lake Superior	Lake Michigan	Lake Huron	Lake Erie	Lake Ontario
Contaminants in Edible Fish	Unchanging	Improving	Unchanging	Deteriorating	Improving

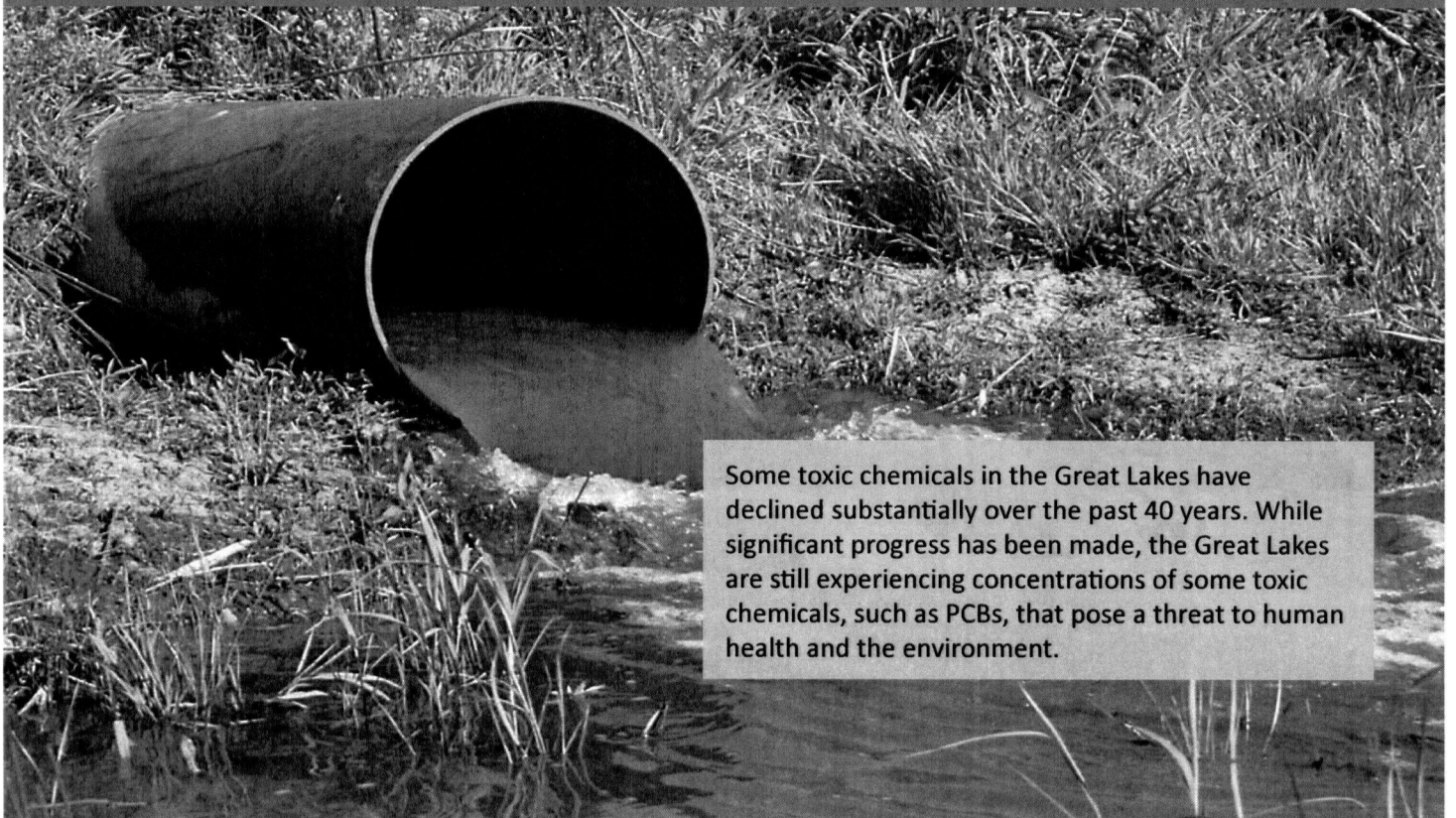
Status: **GOOD** **FAIR** **POOR** **UNDETERMINED**



Toxic Chemicals

Status: Fair Trend: Unchanging to Improving

The 2012 Great Lakes Water Quality Agreement states that *"the Waters of the Great Lakes should be free from pollutants in quantities or concentrations that could be harmful to human health, wildlife, or aquatic organisms, through direct exposure or indirect exposure through the food chain"*



Some toxic chemicals in the Great Lakes have declined substantially over the past 40 years. While significant progress has been made, the Great Lakes are still experiencing concentrations of some toxic chemicals, such as PCBs, that pose a threat to human health and the environment.

Toxic Chemicals

Assessment Highlights

The Toxic Chemicals indicator shows that nearly all older and regulated or banned chemicals, generally referred to as legacy contaminants and include Polychlorinated Biphenyls (PCBs) and mercury, have decreased over the past 40 years. In general, non-legacy compounds, such as Polybrominated Diphenylethers (PBDEs), have shown slow declines in recent years, although some replacements for these compounds are increasing in the environment. Overall, the status of Toxic Chemicals is **Fair** and the trend is **Unchanging to Improving**.

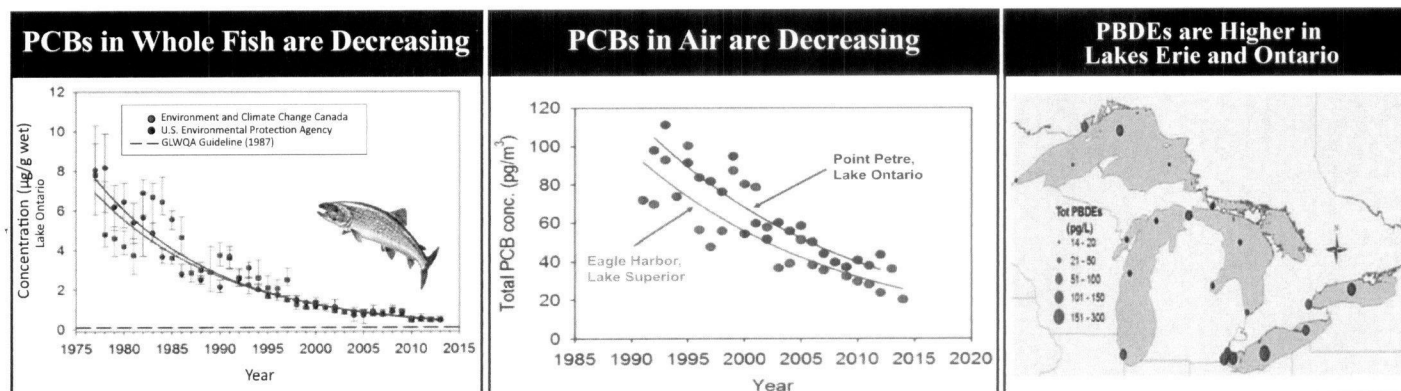
In the offshore waters of the Great Lakes, the long-term trends for many contaminants, such as PCBs and PBDEs, show declines to lower levels and little or no change in the more recent trend, although concentrations are higher in the lower lakes. There are however, occasional exceedances of water quality objectives and criteria for PCBs.

Contaminant levels in Great Lakes whole fish and Herring Gull eggs have decreased significantly since the 1970s. Although declines are being seen, concentrations of some compounds, like PCBs and PBDEs, may still exceed environmental quality guidelines or objectives. Localized

areas of highly contaminated sediment in Areas of Concern (AOCs) and hazardous waste sites may continue to act as sources of these and other contaminants to the lakes. Residual sources of PCBs remain in the Great Lakes Basin and throughout the world. PCBs and other chemicals can be carried by air currents from within and outside the basin to the Great Lakes; therefore, atmospheric deposition will remain a significant source of PCBs and other contaminants for decades into the future.

The Toxic Chemicals indicator includes data from several long-term monitoring programs. These programs have been tracking a wide variety of chemicals including mercury, PCBs and PBDEs in the environment for years, and in some cases, decades. The number of substances being monitored is increasing and evolving, thereby improving our base of knowledge to lead to more robust assessments; including chemicals such as current-use pesticides, pharmaceuticals and personal care products.

Refer to the *State of the Great Lakes 2017 Technical Report* for chemicals monitored in the Great Lakes.



Sub-Indicators Supporting the Indicator Assessment

Sub-Indicator	Lake Superior	Lake Michigan	Lake Huron	Lake Erie	Lake Ontario
Toxic Chemical Concentrations	Improving	Unchanging	Unchanging	Unchanging	Unchanging
Toxic Chemicals in Sediments	Unchanging	Unchanging	Unchanging	Improving	Improving
Toxic Chemicals in Great Lakes Whole Fish	Unchanging	Improving	Unchanging	Unchanging	Improving
Toxic Chemicals in Great Lakes Herring Gull Eggs	Improving	Improving	Improving	Unchanging	Unchanging
Atmospheric Deposition of Toxic Chemicals	No lake was assessed separately Great Lakes Basin assessment is Fair and Improving				

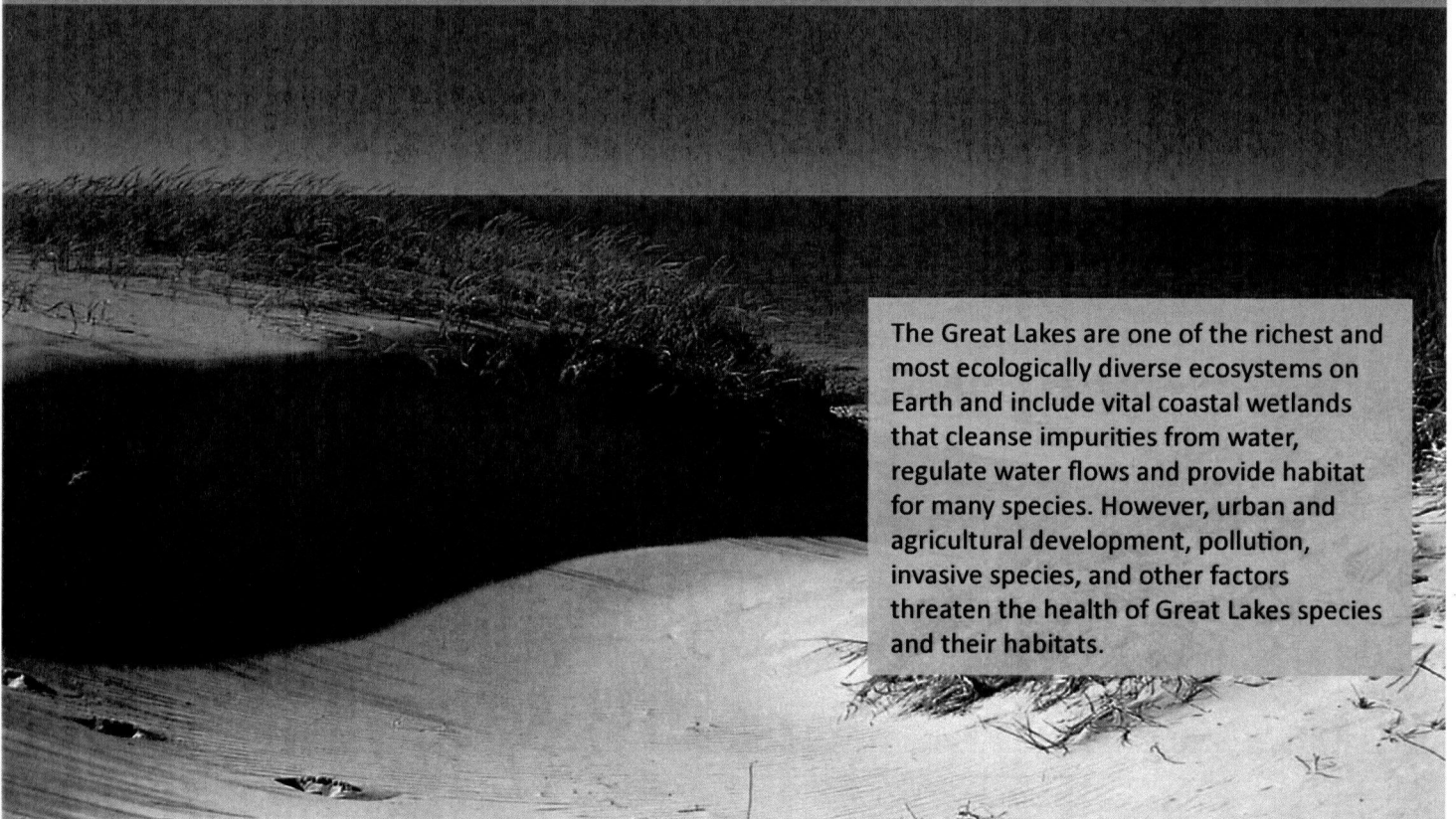
Status:	GOOD	FAIR	POOR	UNDETERMINED
---------	------	------	------	--------------



Habitat and Species

Status: Fair Trend: Unchanging

The 2012 Great Lakes Water Quality Agreement states that *"the Waters of the Great Lakes should support healthy and productive wetlands and other habitats to sustain resilient populations of native species"*



The Great Lakes are one of the richest and most ecologically diverse ecosystems on Earth and include vital coastal wetlands that cleanse impurities from water, regulate water flows and provide habitat for many species. However, urban and agricultural development, pollution, invasive species, and other factors threaten the health of Great Lakes species and their habitats.

Habitat and Species

Assessment Highlights

The Habitat and Species indicator is used to assess habitats, such as wetlands, along with the species that reside in these areas. The Habitat and Species indicator shows that across the basin, the status is quite variable, ranging from good to poor and improving to deteriorating, depending on the lake basin and habitat or species of interest. The health of various species in the Great Lakes is also reflective of the availability and condition of the habitat that they dwell in and need. Overall, the Habitat and Species indicator is assessed as **Fair** and **Unchanging**.

Coastal Wetlands

Despite the fact that coastal wetland restoration and protection efforts have improved specific areas, wetlands continue to be lost and degraded. Efforts to better track and determine the extent and rate of this loss are currently underway. In the southern lakes region, almost all coastal wetlands are degraded by nutrient enrichment, sedimentation, or a combination of both. In Lake Ontario, water-level regulation also limits natural variation in wetlands, though work is underway to address this situation. A more recent concern in the southern lakes region and Lake Huron is the expansion of the invasive Frog-bit, a floating plant that forms dense mats capable of eliminating native submergent plants in coastal wetlands. Of similar concern, the invasive Water Chestnut is expanding rapidly in Lake Ontario.

Coastal wetland habitats in some regions of the Great Lakes, in particular in the northern parts, are intact and show fewer signs of impairment. Across the basin, improvements have

also been seen in the diversity of coastal wetland fish species with recent data showing an average of 10 to 13 species per coastal wetland, with some wetlands having as many as 28. Although many invertebrates, birds and plants have experienced long-term declines, some birds and amphibians are showing a more recent unchanging trend. These stable populations may be preliminary indications of some progress in the rehabilitation and restoration of coastal wetlands.



Sub-Indicators Supporting the Indicator Assessment

Sub-Indicator	Lake Superior	Lake Michigan	Lake Huron	Lake Erie	Lake Ontario
Coastal Wetland Amphibians	Unchanging	Unchanging	Unchanging	Unchanging	Unchanging
Coastal Wetland Birds	Unchanging	Unchanging	Unchanging	Deteriorating	Improving
Coastal Wetland Fish	No lake was assessed separately Great Lakes Basin assessment is Fair and Improving				
Coastal Wetland Invertebrates	No lake was assessed separately Great Lakes Basin assessment is Fair and Deteriorating				
Coastal Wetland Plants	Undetermined	Undetermined	Deteriorating	Deteriorating	Unchanging
Coastal Wetlands: Extent and Composition	No lake was assessed separately Great Lakes Basin assessment is Undetermined				
Aquatic Habitat Connectivity	Improving	Improving	Improving	Improving	Improving

Status:	GOOD	FAIR	POOR	UNDETERMINED
---------	------	------	------	--------------

Habitat and Species

Aquatic Food Web

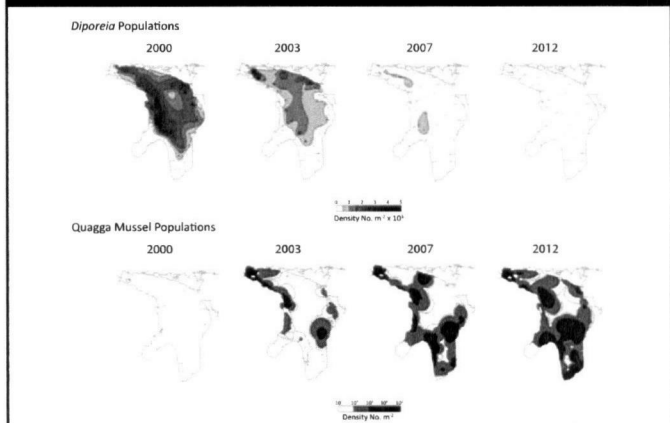
The Great Lakes aquatic food web is made of many important species, ranging from tiny plants and animals (phytoplankton and zooplankton) to top predator fish. Zooplankton communities in all lakes except Lake Huron are generally in good condition, although changes in quantity, density and type are occurring in Lakes Michigan and Ontario. Changes that are occurring in zooplankton communities are consistent with decreasing nutrient concentrations in offshore waters. Low nutrients levels result in a loss of algae for zooplankton to feed on. Also, *Diporeia*, a small bottom-dwelling shrimp-like species and an important source of food for fish, has severely declined in all the lakes except Lake Superior. The invasive dreissenid mussels (specifically Zebra and Quagga Mussels) have likely compounded this problem. Dreissenid mussels graze on phytoplankton and small zooplankton as well as filter and store nutrients which can prevent the movement of nutrients into the open waters of the lake. The situation is complex and the exact mechanisms causing these changes in *Diporeia* and zooplankton have yet to be fully determined.

Zooplankton and phytoplankton communities are the main source of food for prey fish and are essential to sustaining a healthy food web. Prey fish communities across the Great Lakes continue to change, although the direction and magnitude of those changes vary. The prey fish community is considered fair overall based on the diversity and the proportion of native prey fish species in the Great Lakes despite fluctuations in population levels. The abundance of prey fish is influenced by food availability and the abundance of predator fish, such as Lake Trout and Walleye, which eat

prey fish to survive. A balance between the numbers of top predator fish and the available prey fish in the lakes is important.

The status of populations of native predator fish, such as Walleye and Lake Trout, is variable; however, populations of these fish are improving in some cases. Lake Trout populations, for example, are improving in some areas of the Great Lakes with support from stocking and rehabilitation efforts. In fact, natural reproducing populations of Lake Trout are now routinely detected in southwestern Lake Michigan, and wild Lake Trout make up over 50% of the population in Lake Huron. While changes in Lake Sturgeon status will take a long time to manifest, activities such as habitat improvements, dam removals, and stocking efforts indicate an improving trend for this species.

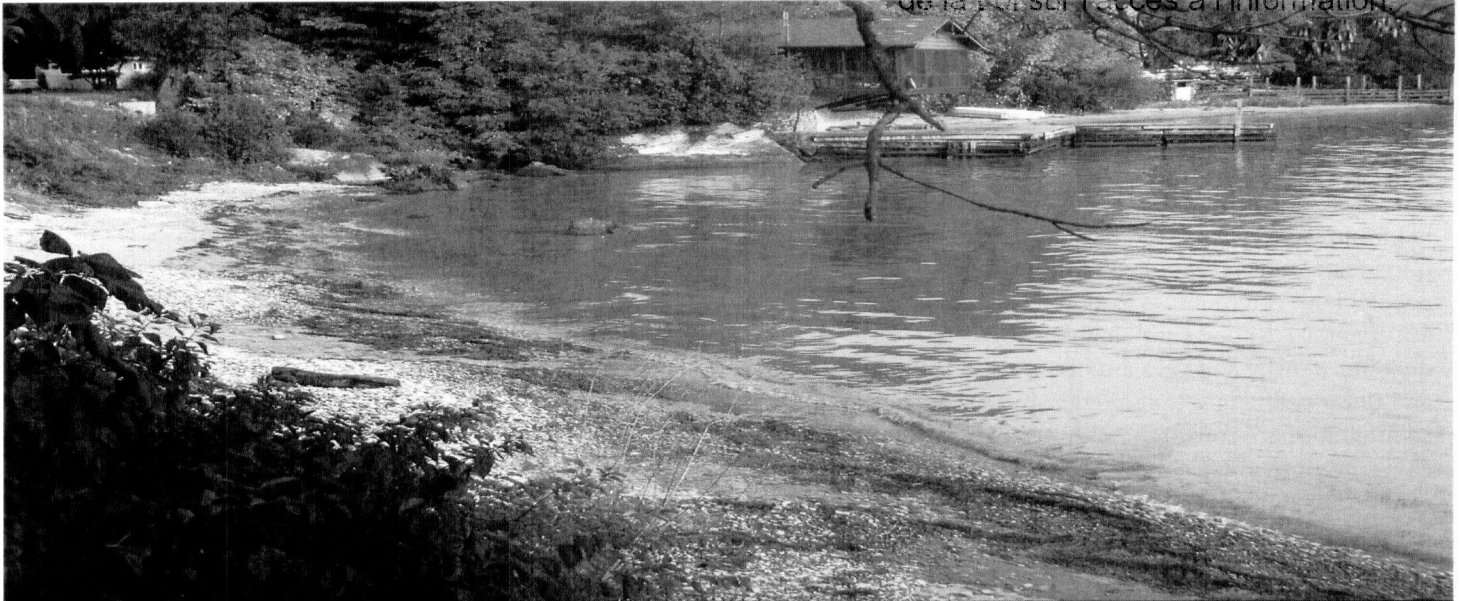
Diporeia Are Declining - Quagga Mussels are Increasing



Sub-Indicators Supporting the Indicator Assessment

Sub-Indicator	Lake Superior	Lake Michigan	Lake Huron	Lake Erie	Lake Ontario
Phytoplankton	Unchanging	Deteriorating	Deteriorating	Deteriorating	Unchanging
Zooplankton	Unchanging	Unchanging	Unchanging	Unchanging	Unchanging
Benthos	Unchanging	Unchanging	Unchanging	Deteriorating	Unchanging
<i>Diporeia</i>	Unchanging	Deteriorating	Deteriorating	Deteriorating	Deteriorating
Prey fish	Unchanging	Deteriorating	Undetermined	Improving	Deteriorating
Lake Sturgeon	Improving	Improving	Improving	Improving	Improving
Walleye	Unchanging	Unchanging	Unchanging	Improving	Unchanging
Lake Trout	Unchanging	Improving	Improving	Improving	Improving
Fish Eating and Colonial Nesting Waterbirds	Unchanging	Unchanging	Unchanging	Unchanging	Unchanging

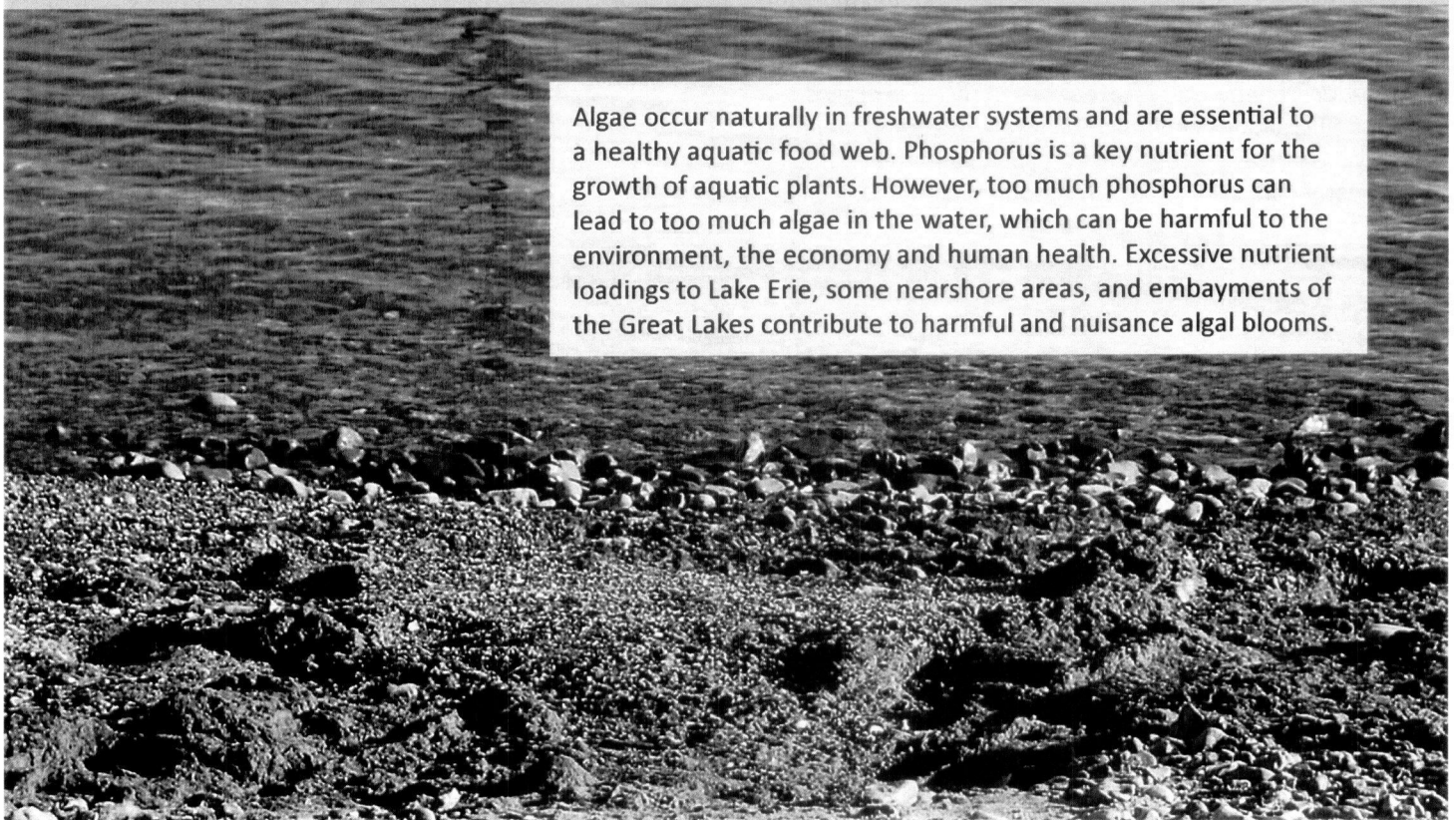
Status: GOOD FAIR POOR UNDETERMINED



Nutrients and Algae

Status: Fair Trend: Unchanging to Deteriorating

The 2012 Great Lakes Water Quality Agreement states that *“the Waters of the Great Lakes should be free from nutrients that directly or indirectly enter the water as a result of human activity, in amounts that promote growth of algae and cyanobacteria that interfere with aquatic ecosystem health, or human use of the ecosystem”*



Algae occur naturally in freshwater systems and are essential to a healthy aquatic food web. Phosphorus is a key nutrient for the growth of aquatic plants. However, too much phosphorus can lead to too much algae in the water, which can be harmful to the environment, the economy and human health. Excessive nutrient loadings to Lake Erie, some nearshore areas, and embayments of the Great Lakes contribute to harmful and nuisance algal blooms.

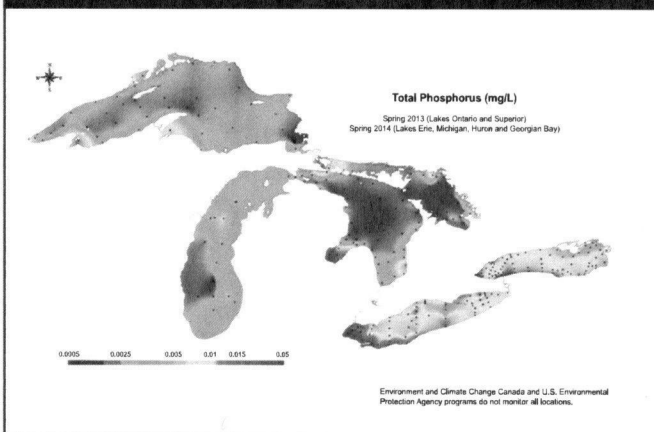
Nutrients and Algae

Assessment Highlights

The 1972 GLWQA focused on phosphorus reductions. In the 1980s and early 1990s, basin-wide restoration efforts were successful in reducing nutrient-related runoff and conditions in the lakes improved. These efforts included the regulation of phosphorus concentrations in detergents, investments in sewage treatment, and the implementation of best management practices on agriculture lands and in expanding urban areas. Despite these efforts, there is a nutrient imbalance in the Great Lakes. With the recent resurgence of the nearshore algal problem in some areas and with other changes in the ecosystem, the problem has become more complicated. Overall, the conditions result in a status of **Fair** and a trend of **Unchanging** to **Deteriorating** for this indicator.

Many offshore regions of some of the Great Lakes have nutrient levels below desired concentrations. In fact, concentrations may be too low in some areas, resulting in insufficient growth of key phytoplankton species which form the base of the food chain. Only in Lake Superior are offshore phosphorus concentrations considered in acceptable condition. Conversely, there are excess nutrients in many nearshore areas. While a certain level of nutrients is good, too much may lead to the development of nuisance and harmful algal blooms (HABs) and hypoxic zones (areas with low oxygen levels). This issue is primarily a concern in Lake Erie, parts of Lake Ontario, Saginaw Bay and Green Bay, along with other nearshore areas that experience elevated nutrient levels. Algal blooms can be harmful to both ecosystem and human health. The western basin of Lake Erie and some parts of Lake Ontario have experienced a resurgence of HABs since 2008, adversely impacting ecosystem health as well as commercial fishing, municipal drinking water systems and recreational activities. Algal blooms are particularly harmful when they are dominated by cyanobacteria (or “blue-green” algae) which can produce toxins such as microcystin. These toxins can impact drinking water safety or can cause gastrointestinal upsets, skin rashes and at elevated levels can be fatal to many organisms.

Total Phosphorus Concentrations in the Great Lakes



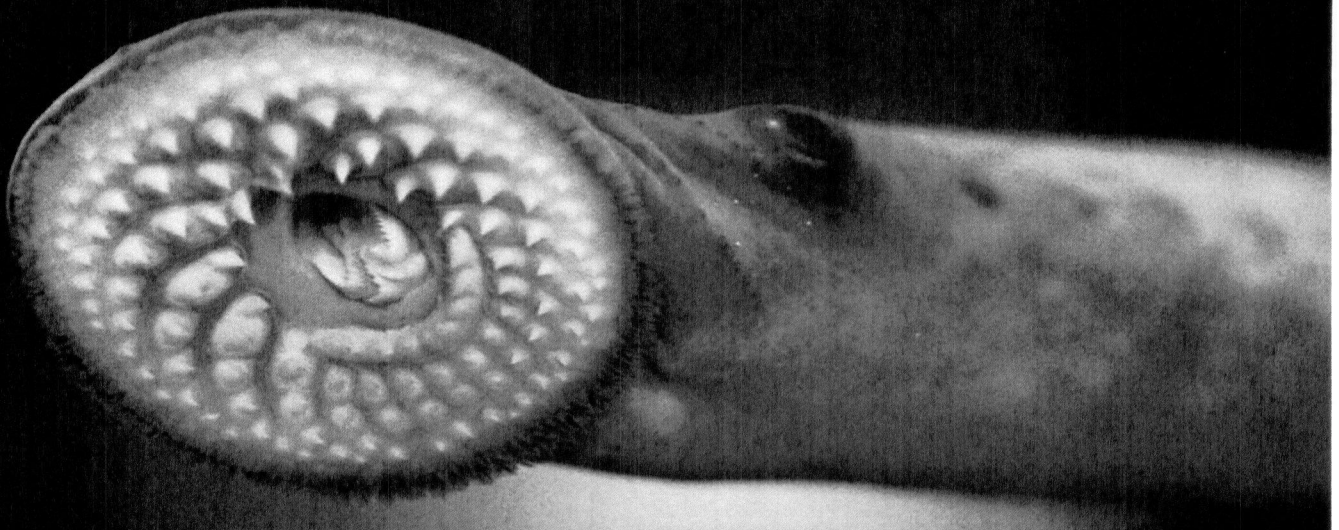
Cladophora is a nuisance algae that is broadly distributed over large areas of the nearshore regions of Lakes Erie, Ontario, Huron and Michigan. Large mats of *Cladophora* give the impression that nutrient concentrations are high in the nearshore. However, in some areas, these mats of nuisance algae persist despite low nutrient concentrations in the surrounding water, which is why the management of *Cladophora* has become such a challenge. Excessive *Cladophora* poses many problems including beach and shoreline fouling, clogging of municipal water intakes and unpleasant aesthetics, as well as tourism and recreational fishing impacts. There are also significant ecological impacts of excessive *Cladophora* growth and, when washed up on the shoreline, *Cladophora* may harbour pathogens and create an environment conducive to the development of botulism outbreaks which pose a risk for fish and wildlife.

Warmer temperatures, higher frequency and intensity of precipitation events, and invasive species, in particular Zebra and Quagga Mussels, are confounding factors in the cycling and uptake of nutrients in the lakes. These factors may lead to increased frequency, distribution and severity of HABs, hypoxic zones and *Cladophora*.

Sub-Indicators Supporting the Indicator Assessment

Sub-Indicator	Lake Superior	Lake Michigan	Lake Huron	Lake Erie	Lake Ontario
Nutrients in Lakes	Unchanging	Deteriorating	Deteriorating	Deteriorating	Deteriorating
<i>Cladophora</i>	Unchanging	Undetermined	Undetermined	Undetermined	Undetermined
Harmful Algal Blooms	Undetermined	Undetermined	Undetermined	Deteriorating	Deteriorating
Water Quality in Tributaries	Unchanging	Undetermined	Unchanging	Unchanging	Unchanging

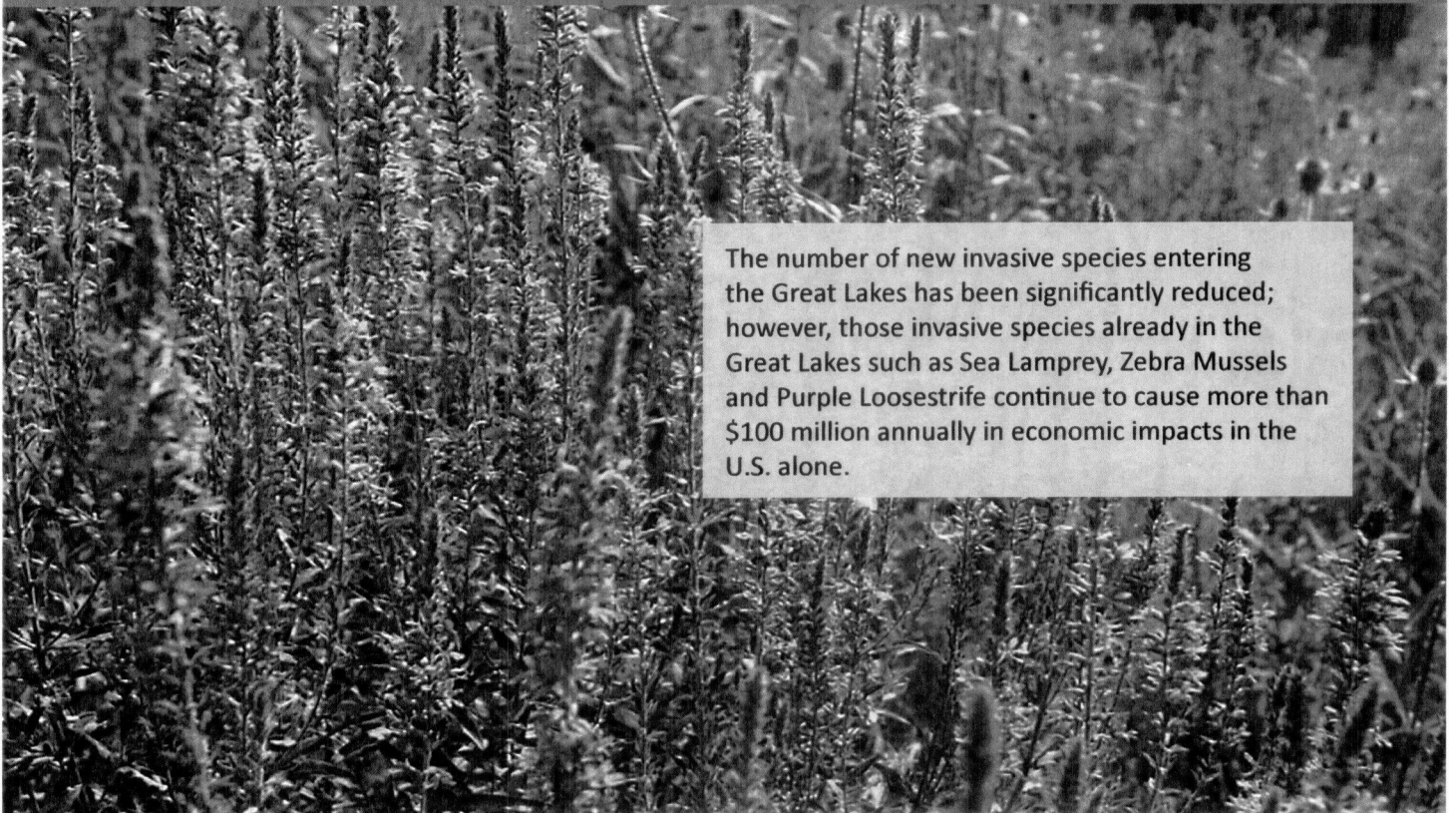
Status: **GOOD** **FAIR** **POOR** **UNDETERMINED**



Invasive Species

Status: Poor Trend: Deteriorating

The 2012 Great Lakes Water Quality Agreement states that *"the Waters of the Great Lakes should be free from the introduction and spread of aquatic invasive species and free from the introduction and spread of terrestrial invasive species that adversely impact the quality of the Waters of the Great Lakes"*



The number of new invasive species entering the Great Lakes has been significantly reduced; however, those invasive species already in the Great Lakes such as Sea Lamprey, Zebra Mussels and Purple Loosestrife continue to cause more than \$100 million annually in economic impacts in the U.S. alone.

Invasive Species

Assessment Highlights

The Invasive Species indicator highlights that the spread and impact of aquatic and terrestrial invasive species continues to be a significant stress to biodiversity in the Great Lakes region. As such, the Invasive Species indicator is assessed as **Poor** and the trend is **Deteriorating**.

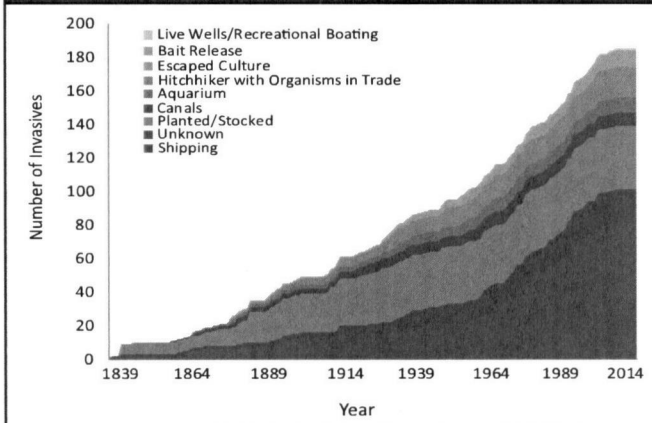
To date, over 180 aquatic non-native species have become established in the Great Lakes Basin. Only **one** new non-native species has been discovered since 2006, a zooplankton called *Thermocyclops crassus*. This tremendous success in reducing the introduction of invasive species is largely due to the regulation of ballast water from trans-oceanic ships. Additionally, the Asian carp species established in the Mississippi River, which are threatening the Great Lakes, have not become established. This success is attributed to the important prevention efforts in both countries, including the U.S. Army Corps of Engineers electrical barrier on the Chicago Sanitary and Ship Canal.

Despite the significant slowdown in recent introductions, the impacts of established invaders persist and their ranges within the lakes are expanding. It is believed that at least 30% of the aquatic non-native species found in the Great Lakes have significant environmental impact.

For several decades, Sea Lamprey have been causing severe ecological impacts. However, Sea Lamprey abundance has been reduced significantly in the five lakes through active, ongoing, and basin-wide control measures. But, native fish such as Lake Trout, Walleye and Lake Sturgeon are still subject to Sea Lamprey predation. Sea Lamprey remain an impediment to achieving critical fish community and ecosystem objectives and therefore continuation of and improvements to Sea Lamprey control are required.

Dreissenid mussels, also known as Zebra and Quagga Mussels, are prominent invasive species in the Great Lakes as well. In many offshore regions, Zebra Mussels have been displaced

Aquatic Invasive Species - Establishments Have Slowed Down



by increasing populations of Quagga Mussels. While in some nearshore regions, populations of both species seem to be stable or declining. Overall, dreissenids are a dominant component of the bottom-dwelling community. Consequently, they have played an instrumental role in the alteration of the zooplankton and phytoplankton communities as well as disrupting the nutrient cycle and increasing water clarity.

On the land, terrestrial invasive species have a significant impact and continue to spread throughout the Great Lakes Basin. Five terrestrial invasive species were assessed collectively—*Phragmites*, Purple Loosestrife, Garlic Mustard, Emerald Ash Borer and Asian Long-horned Beetle. These species are widely distributed and their ranges appear to be expanding. All five of these species have a detrimental impact on the surrounding ecosystem, including degrading habitat and water quality.

Limiting the impact of existing invaders is critical. However, binational prevention efforts, including continuing early detection and rapid response programs, are where the biggest difference can be made to ensure the Great Lakes are healthy, safe and sustainable.

Sub-Indicators Supporting the Indicator Assessment

Sub-Indicator	Lake Superior	Lake Michigan	Lake Huron	Lake Erie	Lake Ontario
Impacts of Aquatic Invasive Species	Deteriorating	Deteriorating	Deteriorating	Deteriorating	Deteriorating
Dreissenid Mussels	Unchanging	Deteriorating	Deteriorating	Improving	Deteriorating
Sea Lamprey	Improving	Improving	Improving	Improving	Unchanging
Terrestrial Invasive Species	Deteriorating	Deteriorating	Deteriorating	Deteriorating	Deteriorating

Status: **GOOD** **FAIR** **POOR** **UNDETERMINED**

Groundwater

Status: Fair Trend: Undetermined

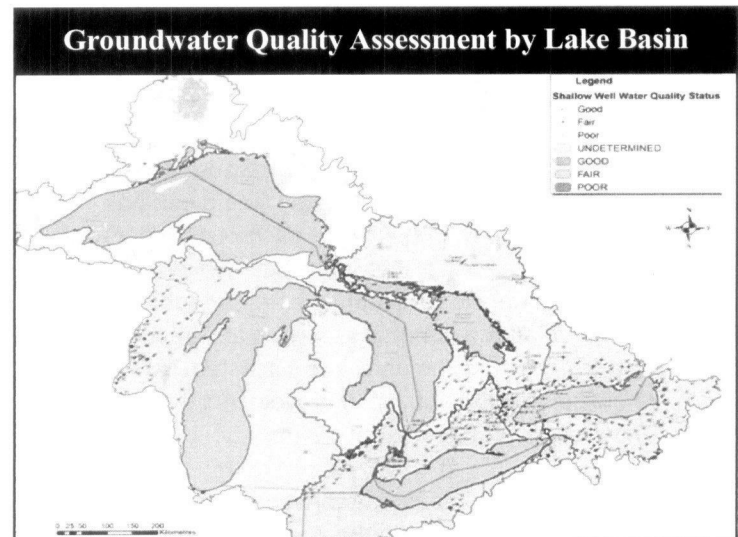
Groundwater can enhance surface water quality and quantity and provide essential aquatic habitats. Groundwater can also transmit contaminants and excessive loads of nutrients to the Great Lakes.

The 2012 Great Lakes Water Quality Agreement states that *"the Waters of the Great Lakes should be free from the harmful impact of contaminated groundwater"*

Assessment Highlights

The Groundwater Quality indicator is assessed as **Fair** but the trend is **Undetermined** due to insufficient long-term data. The concentrations of nitrate, primarily from agricultural practices, and chloride, mainly from the urban use of de-icing salt, are being used to assess groundwater quality. Elevated concentrations of both of these constituents in water can have detrimental impacts to ecosystem and human health.

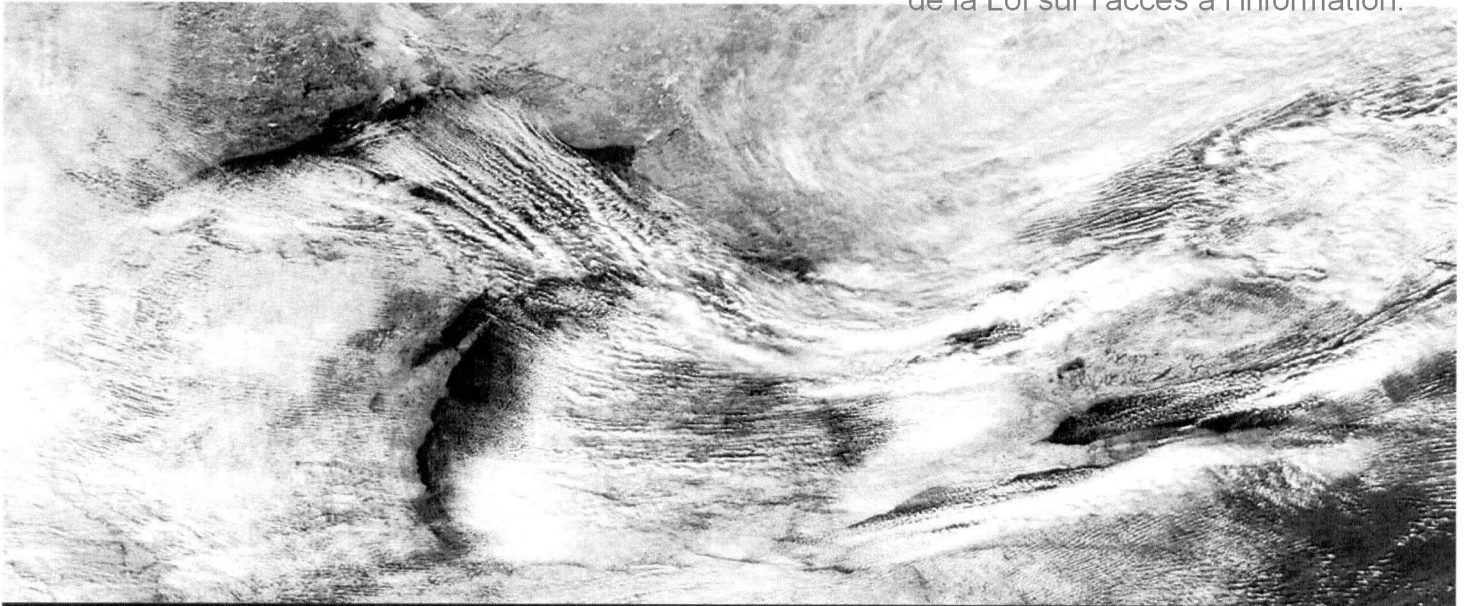
Portions of the Great Lakes Basin with more intense development, such as areas within the basins of Lakes Michigan, Erie and Ontario, are generally assessed as fair. Groundwater quality is generally assessed as good in the less developed areas, such as portions of the Lake Huron basin. A better understanding about the impacts of contaminated groundwater and its interaction with the waters of the Great Lakes is needed, particularly for the nearshore zone.



Sub-Indicators Supporting the Indicator Assessment

Sub-Indicator	Lake Superior	Lake Michigan	Lake Huron	Lake Erie	Lake Ontario
Groundwater Quality	Undetermined	Undetermined	Undetermined	Undetermined	Undetermined

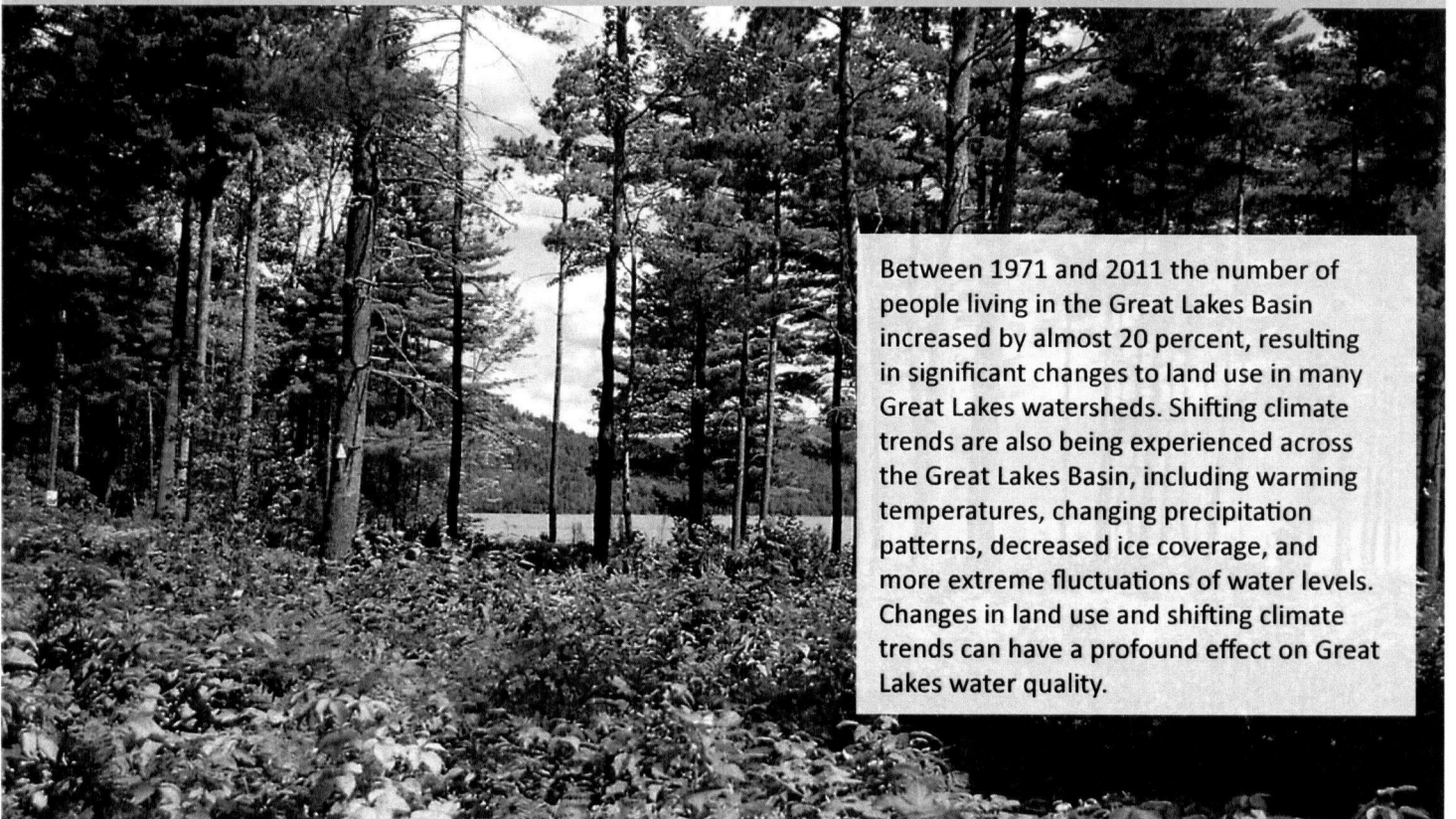
Status:	GOOD	FAIR	POOR	UNDETERMINED
---------	------	------	------	--------------



Watershed Impacts and Climate Trends

Status: Fair Trend: Unchanging

The 2012 Great Lakes Water Quality Agreement states that *“the Waters of the Great Lakes should be free from other substances, materials or conditions that may negatively impact the chemical, physical or biological integrity of the Waters of the Great Lakes”*



Between 1971 and 2011 the number of people living in the Great Lakes Basin increased by almost 20 percent, resulting in significant changes to land use in many Great Lakes watersheds. Shifting climate trends are also being experienced across the Great Lakes Basin, including warming temperatures, changing precipitation patterns, decreased ice coverage, and more extreme fluctuations of water levels. Changes in land use and shifting climate trends can have a profound effect on Great Lakes water quality.

Watershed Impacts and Climate Trends

Assessment Highlights

Overall, the Watershed Impacts and Climate Trends indicator is assessed as **Fair** and **Unchanging**. This indicator includes all “other substances, materials or conditions” that are not highlighted in the eight other indicators noted on page 2, but are important with respect to the state of the Great Lakes. The indicator currently includes an array of land-based conditions which can affect water quality as well as climate trends which can impact all parts of the ecosystem.

Watershed Impacts

Population, development, agriculture and road density can cause land-based pressures on the Great Lakes ecosystem, especially in areas with larger population centres. Although urban and agricultural lands are important to the Great Lakes region because they help support people and the economy, the water quality in these areas, in particular the lower lake basins, is more susceptible to impairments or threats. Conversely, the northern part of the Great Lakes Basin has lower relative amount of stress since it remains largely undeveloped and is dominated by natural cover.

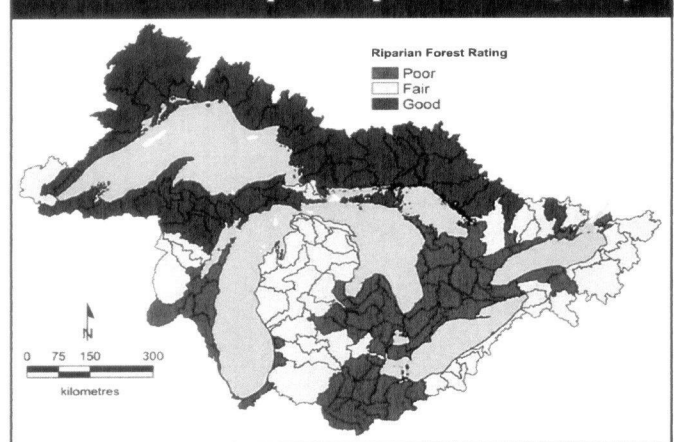
Across the entire basin, almost 400 square kilometres (154 square miles) or 40,000 hectares of natural lands were converted to developed land cover between 2001 and 2011. The latest analysis shows a growing trend of increasing development, resulting in a loss of agricultural, forested and natural lands.

Research has shown that an increase in forest cover improves water quality. In particular, forest cover within a riparian zone (i.e. land along a lake, river or stream), plays a key role in stabilizing soil and can help reduce the amount of runoff from the land and reduce nutrient loadings and other non-point source pollutants. Forest cover in the riparian zones varies with the Lake Superior watershed having the highest amount at 96% and the Lake Erie watershed having the least with 31%. With half of the Great Lakes Basin currently in agricultural or developed land use, and with much less forest cover in the more southern parts of the Great Lakes Basin, it is evident that land-based pressures can significantly impact water quality.

Agricultural Lands in the Southern Parts of the Great Lakes Basin



Forest Cover Helps to Improve Water Quality



Sub-Indicators Supporting the Indicator Assessment

Sub-Indicator	Lake Superior	Lake Michigan	Lake Huron	Lake Erie	Lake Ontario
Forest Cover	Unchanging	Unchanging	Unchanging	Improving	Deteriorating
Land Cover	Unchanging	Unchanging	Unchanging	Unchanging	Unchanging
Watershed Stressors	Unchanging	Unchanging	Unchanging	Unchanging	Unchanging
Hardened Shorelines	Undetermined	Undetermined	Undetermined	Undetermined	Deteriorating
Tributary Flashiness	No lake was assessed separately Great Lakes Basin trend is Unchanging				
Human Population	Decreasing	Increasing	Increasing	Increasing	Increasing

Status: **GOOD** **FAIR** **POOR** **UNDETERMINED**

Watershed Impacts and Climate Trends

Climate Trends

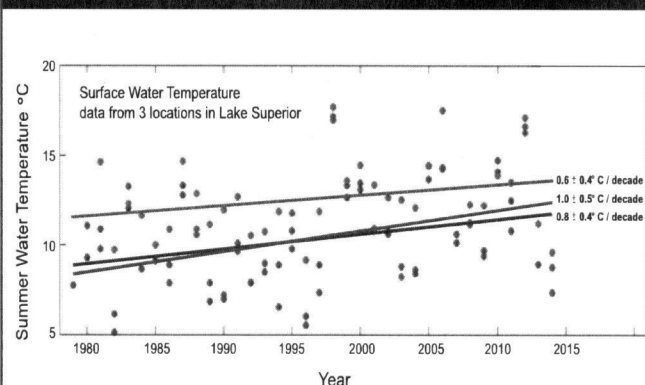
Data collected over the past 30-40 years in the Great Lakes Basin show increases in the amount of precipitation, increases in summer surface water temperature and a reduction in ice cover. Lake levels have also generally decreased, although there has been a recent rebound in water levels in the past few years. It is not yet possible to say with any certainty, however, if changes in water levels are due to human activity or natural long-term cycles.

These changes can affect the health of the Great Lakes Basin including impacts to spawning and other habitats for fish species, the amount and quality of coastal wetlands and changes in forest composition. Shifts in climate trends can also lead to the northward migration of invasive species and alter habitat in a way that favours some invaders over native species. An extended growing season, increases in runoff and nutrient loads and changes to contaminant cycling could also result from a shift in climate trends.

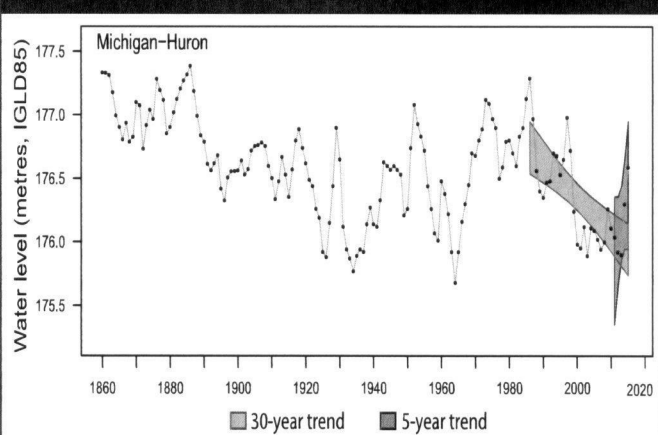
Assessing Climate Trends

Climate information is not assessed in the same manner as other indicators in this report. For example, the ecosystem has adapted to and needs both high and low water levels and neither condition can be assessed as **Good** or **Poor**. However, prolonged periods of high or low water levels may cause stress to the ecosystem. Therefore, climate trends are simply assessed as **Increasing**, **Unchanging** or **Decreasing** over a defined period of time.














Surface Water Temperatures are Increasing



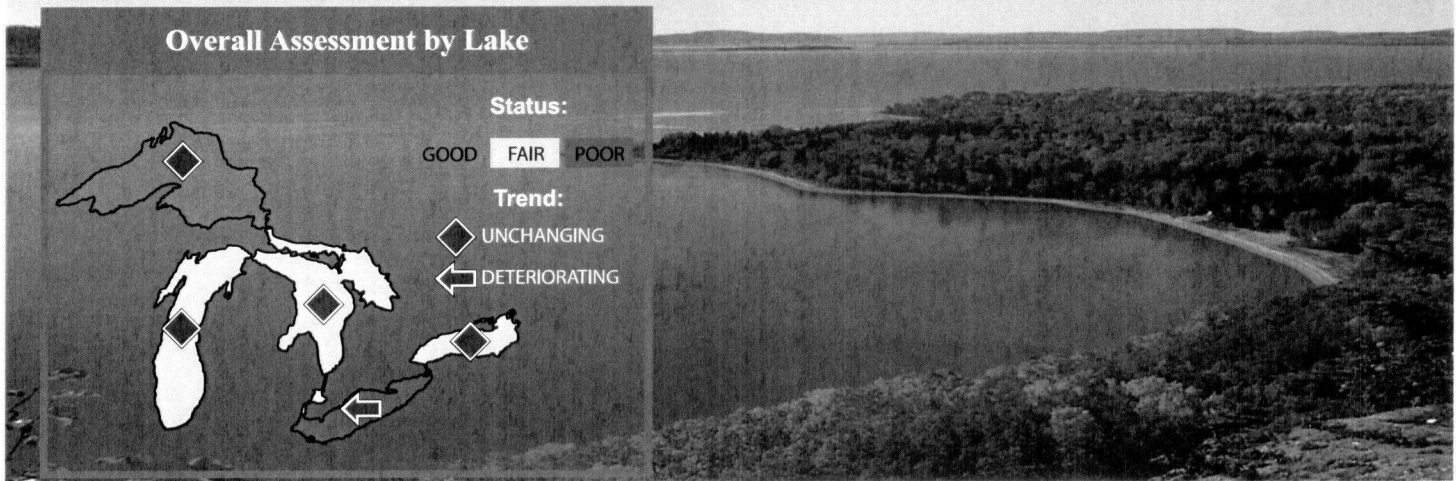
Water Levels Fluctuate



Sub-Indicators Supporting the Indicator Assessment

Sub-Indicator	Lake Superior	Lake Michigan	Lake Huron	Lake Erie	Lake Ontario
Precipitation Amounts (1948-2015)	No lake was assessed separately Great Lakes Basin trend is 				
Surface Water Temperature (1979/1980-2014)				Undetermined	Undetermined
Ice Cover (1973-2015)					
Water Levels (1985-2015)					No significant change
Baseflow Due to Groundwater	No lake was assessed separately Great Lakes Basin trend is Undetermined				

Lake-by-Lake Snap Shot

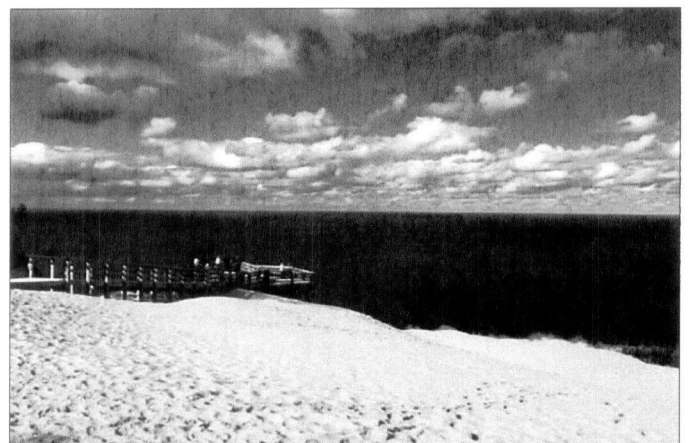


Lake Superior's ecosystem is in good condition and the trend is unchanging. Fisheries in the open waters are in good condition, supported by a robust lower food web including small, shrimp-like species *Diporeia* and *Mysis*. There are self-sustaining populations of Lake Trout and increasing abundance of Lake Sturgeon. Most major habitats are in good condition on a lakewide scale, including coastal wetlands. Concentrations of legacy contaminants in the environment, such as PCBs, are generally decreasing or remaining stable. However, fish consumption advisories continue to be in effect due to pollutants such as mercury and PCBs. Aquatic invasive species, in particular Sea Lamprey, are still causing harm. In addition, warming waters are stressing some cold-water species, such as Brook Trout. Areas of degraded habitat or impaired habitat connectivity between the tributaries and the lake are impacting native species. Contaminants of emerging concern, such as microplastics, have been detected.

Lake Michigan's ecosystem is in fair condition and the trend is unchanging. Removal of contaminated sediment and habitat improvement are occurring in AOCs; White Lake has been formally removed from the list of designated AOCs and management actions have been completed at three other AOCs. Chemical pollutants have declined significantly since the 1970s; however, fish and wildlife consumption advisories remain in place. In some nearshore areas, elevated phosphorus concentrations are observed, while offshore phosphorus concentrations are below objectives and continue to decrease. *Diporeia* have almost disappeared, and filter-feeding by invasive



Lake Superior alone has 11.4 quadrillion litres (3 quadrillion gallons) of water - enough to submerge North and South America under 30 centimetres (1 foot) of fresh water.

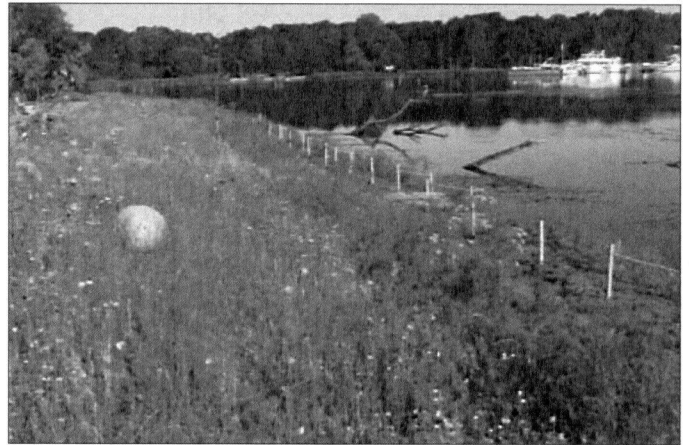


Lake Michigan is home to the world's largest freshwater sand dunes, attracting millions of visitors annually.

Lake-by-Lake Snap Shot

Quagga Mussels has reduced the food available for prey fish and the juveniles of economically important sport fish (e.g. Yellow Perch) and commercial species (e.g. Lake Whitefish). Record low abundance estimates for most prey fish populations, combined with increased natural reproduction of predator fish, have prompted stocking reductions for salmon and trout, cornerstone species for the multi-billion dollar sport fishing industry. However, in a few places, Lake Trout, the top native predator fish, has shown signs of natural reproduction for the first time in decades, due in part to the successful control of Sea Lamprey.

Lake Huron's ecosystem is in fair condition and the trend is unchanging. It has extensive beaches and its nearshore areas provide excellent opportunities for swimming and recreation. Chemical pollutants have declined significantly since the 1970s; however, fish and wildlife consumption advisories remain to protect human health. The majority of nearshore waters are of high quality, but areas of the southeast shore, Saginaw Bay, and parts of eastern Georgian Bay experience periodic harmful or nuisance algal blooms. Nutrient and algae levels in the offshore are variable, but largely below targets. Zebra and Quagga Mussels are associated with decline in nutrient levels and nutrient availability to other aquatic organisms, increased water clarity, nuisance algae growth and are suspected to facilitate episodic botulism outbreaks in parts of the basin. *Diporeia*, a major food source for prey fish, are declining, resulting in negative consequences for recreational and commercial fisheries. However, Walleye have largely recovered in Michigan waters of Lake Huron and, in the absence of the invasive Alewife, Lake Trout populations are approaching reproduction targets.



More than 75,000 cubic metres (100,000 cubic yards) of contaminated sediment were removed from White Lake resulting in improved water quality and the return of fish and wildlife populations in Lake Michigan.



Lake Huron has the longest shoreline, including islands, of the Great Lakes extending 6,159 km (3,827 miles).



Lake-by-Lake Snap Shot

Lake Erie's ecosystem is in poor condition and the trend is deteriorating. Harmful algal blooms resulting from excessive nutrient inputs occur regularly in the western basin and Lake St. Clair during summer, and have impacted drinking water treatment systems. Beach closures, habitat loss and degradation, and beach fouling in the eastern basin continue to be major concerns. Increased amounts of decaying algae exacerbate seasonal anoxia (*depleted dissolved oxygen conditions*) and hypoxia (*low oxygen conditons*) in bottom waters of the central basin. Despite the challenges, there are positive ecosystem trends, including increased Walleye across the lake and Lake Sturgeon in the St. Clair-Detroit River System; increased aquatic habitat connectivity due to dam removal and mitigation projects; and declines in Sea Lamprey wounding of fish since 2010. Since 2009, the western Lake Erie Cooperative Weed Management Area partners in Ohio and Michigan have treated more than 13,000 acres of invasive *Phragmites*, resulting in a 70% decrease in live *Phragmites* in Ohio and a resurgence of native plants in Michigan and Ohio.

Lake Ontario's ecosystem is in fair condition and the trend is unchanging. Contaminants in fish, such as PCBs, have steadily decreased, leading to less restrictive consumption advisories. Bald Eagles and Lake Sturgeon populations are recovering. Native deepwater sculpin, a species once thought extirpated, has recovered, while stocking efforts to restore other native prey fish show some signs of success. As a result of two years of poor alewife reproduction, reductions in salmon and trout stocking are needed to address the potential imbalance between predators and prey. Offshore phosphorus concentrations are below the objective and declining nutrient levels may significantly reduce the overall productivity of the lake and change the structure of the lower food web, impacting fish production. In the nearshore waters, despite long-term lake-wide nutrient declines, mats of *Cladophora* are causing problems in some areas due to high phosphorus levels and/or increased water clarity and changes in nutrient cycling following the arrival of the invasive dreissenid mussels.



Lake Erie is the most biologically productive Great Lake, and it also has the biggest sport fishing industry of all the lakes.



The St. Clair River is home to the largest remaining Lake Sturgeon spawning population in the Great Lakes Basin.



Nearly 7.5 million Canadians live in the Lake Ontario watershed, making up almost 20% of the entire Great Lakes Basin population.

Participating Organizations

Many people have been involved with development of the *State of the Great Lakes 2017 Highlights and Technical Reports*. Thank you to the authors and advisory committee members for their continued support.



All photos included in this report are courtesy of U.S. federal agencies, Environment and Climate Change Canada or are available for free use unless otherwise noted below:

Cover Photo and Page 1: © Getty Images

Lake Huron page 2, Lucas Van Landschoot

Drinking Water page 3, Ontario Ministry of Agriculture, Food and Rural Affairs

Wetland (bottom of) page 9, Michigan Sea Grant

Algae (bottom of) page 11, Stacey Cherwaty-Pergentile

Sea Lamprey page 13, Great Lakes Fishery Commission

Purple Loosestrife page 13, Michigan Sea Grant

Groundwater page 15, Norm Grannemann

Forest page 16, Stacey Cherwaty-Pergentile

Lake Superior (top of) page 19, Dave Crawford

Lake Superior (middle of) page 19, Nancy Stadler-Salt

Lake Michigan page 19, Michigan Department of Environmental Quality

Lake Superior (bottom of) page 20, jbailey/infosuperior.com

Lake Erie (top of) page 21, Michigan Sea Grant, Todd Marsee

Back Cover, jbailey/infosuperior.com

The *State of the Great Lakes 2017 Highlights Report* is a summary of science-based information from 44 sub-indicator reports. These sub-indicator reports are included in their entirety in the *State of the Great Lakes 2017 Technical Report*. For more information about the state of the Great Lakes reporting and to access the reports, visit the following websites:

www.binational.net
www.ec.gc.ca/greatlakes
www.epa.gov/greatlakes

Cat. No.: En161-3E-PDF (Online)
ISSN: 2291-1138

Cat. No.: En161-3E (Print)
ISSN: 1924-0279

EPA 950-R-17-001

Aussi disponible en français
État des Grands Lacs 2017 Faits saillants





Government
of Canada

Gouvernement
du Canada

[Home](#) → [Environment and Climate Change Canada](#)

The Government of Canada invests in Great Lakes Protection Initiative

News Release

From [Environment and Climate Change Canada](#)

December 1, 2017 – Toronto, Ontario

Canada is committed to providing strong support to working collaboratively with the Government of Ontario and Indigenous Peoples for the protection and restoration of the Great Lakes.

Today, the Minister of Environment and Climate Change, Catherine McKenna, announced that the Government of Canada will invest \$44.84 million for the Great Lakes Protection Initiative, which is part of the \$70.5 million of new funding allocated for freshwater protection, in Budget 2017.

This investment will tackle issues that matter to the lives of Canadians—from cleaner drinking water, to beaches we can enjoy, to waters in which we can fish and swim.

The Great Lakes region represents the third-largest economy in the world, if measured as a country. It supplies 51 million jobs or nearly 30 percent of the combined American and Canadian workforce. Building on a solid foundation of existing Great Lakes programming, this investment will further focus efforts on issues of greatest importance to Canadians, including the continued implementation of the Canada-United States Great Lakes Water Quality Agreement as well as the Canada-Ontario Agreement on Great Lakes Water Quality and Ecosystem Health. Healthier Great Lakes mean more opportunities for economic growth.

New programming will focus on reducing toxic and nuisance algae and strengthening the resilience of Great Lakes coastal wetlands. It will prioritize identifying at risk nearshore waters, which are those most used by Canadians for drinking and recreation. It will target reducing the release of harmful chemicals. And, it will seek to strengthen engagement with Indigenous Peoples and the public in addressing Great Lakes issues.

Reaffirming the strong Canada-Ontario partnership in the protection of the Great Lakes, Minister McKenna was joined at today's announcement by the Parliamentary Assistant to Ontario's Minister of the Environment and Climate Change, Arthur Potts.

The Minister also convened a round table, moderated by the Council of the Great Lakes Region, to continue ongoing dialogue on the future of the protection of the Great Lakes. Participants included representatives of Indigenous groups, the province of Ontario, municipalities, industry, and environmental non-government organizations.

Quotes

"Canada believes that sustained action on Great Lakes restoration is key to the health and economic prosperity of citizens in this important region. Working alongside American and Canadian partners, the Government of Canada will continue to promote strong action on both sides of the border—to tackle climate change and protect the shared waters of our Great Lakes."

– Catherine McKenna, Minister of Environment and Climate Change

"Ontario is proud to collaborate with Canadian, municipal and international government counterparts, First Nations and Métis partners, and others to restore the Great Lakes. Ontario is continuing to protect the Great Lakes to help ensure they are drinkable, swimmable, and fishable for surrounding communities and future generations."

– Chris Ballard, Ontario Minister of the Environment and Climate Change

"The lakes are critical to Ontario and the binational Great Lakes region. They're also the centrepiece of a regional, cross-border economy. While there's much work to do to restore and protect the Great Lakes, the investment that the Government of Canada is making today will allow us to continue on the path of building the most sustainable and prosperous region in the world."

– Mark Fisher, Chief Executive Officer of the Council of the Great Lakes Region

"These investments will be critical to sustaining efforts to address increasingly pressing issues, from harmful algal blooms in Lake Erie and invasive-species control to the cleanup of polluted areas. This is a clear signal that the federal government recognizes the importance of a healthy Great Lakes ecosystem to Canada's future."

– Tony Maas, Manager of Strategy with Freshwater Future

"Today's Great Lakes federal funding announcement is welcomed by the mayors of communities on the shorelines of the Great Lakes. This funding will support cities and towns in taking action through important on-the-ground projects to reduce phosphorous runoff and naturalize waterfronts."

– Sandra Cooper, Mayor of Collingwood, Ontario, and Vice-Chair of the Great Lakes and St. Lawrence Cities Initiative

Quick Facts

- One out of four Canadians and one out of ten Americans drink Great Lakes water.
- The Great Lakes contain approximately one fifth of the world's fresh water supply.

Associated Links

- [The Great Lakes](#)
- [Binational.net](#)

Contacts

Marie-Pascale Des Rosiers
Press Secretary
Office of the Minister of Environment and Climate Change
613-462-5473
marie-pascale.desrosiers@canada.ca

Media Relations
Environment and Climate Change Canada
819-938-3338 or 1-844-836-7799 (toll free)
ec.media.ec@canada.ca

[Environment and Climate Change Canada's Twitter page](#)

[Environment and Natural Resources in Canada's Facebook page](#)

Search for related information by keyword: [NE Nature and Environment](#) | [Climate](#) | [Environment](#) | [Environment and Climate Change Canada](#) | [Canada](#) | [Environment and natural resources](#) | [general public](#) | [news releases](#) | [Hon. Catherine McKenna](#)

Date modified:

2017-12-01